THE HOPE REPORTS

VOL. V

1903—1906

EDITED BY

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Hon. LL.D. Princeton, F.R.S., F.L.S., F.Z.S., F.G.S., F.E.S.

HOPE PROFESSOR OF ZOOLOGY IN THE UNIVERSITY OF OXFORD
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CORRESPONDING MEMBER OF THE ACADEMY OF SCIENCE, NEW YORK, AND
THE SOCIETY OF NATURAL HISTORY, BOSTON

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1906

THE MAKERS OF THE HOPE DEPARTMENT
OXFORD UNIVERSITY MUSEUM

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PREFACE

The fifth volume of Hope Reports contains a variety of memoirs chiefly published in 1904 and 1905, but some few of them overlapping into 1903 and 1906. Almost the whole of the included publications deal with bionomic subjects, or subjects whose chief interest is bionomic.

The two Presidential Addresses of the Hope Professor to the Entomological Society (3 and 4) attempt to deal with very broad and fundamental questions, which, however, are regarded principally from the bionomic standpoint. Mr. Edward Saunders' important faunistic memoir (13) on the Aculeata of Majorca and Spain contains an appendix and notes on bionomic subjects by the Professor. Excluding the two Presidential Addresses, from the 'Proceedings of the Entomological Society of London' (3 and 4), and paper (2) contributed to the French Entomological Society, memoirs 5–14 inclusive are published in the 'Transactions' of the London Society; and I desire to express my warm appreciation of the ready and sympathetic help always received from the Officers, Council, and Fellows, who have permitted me thus to issue privately these *separata* from their publications.

The ten memoirs (5–14) from the 'Transactions of the Entomological Society' are the work of eight authors, of whom six—viz. all except Mr. Edward Saunders, F.R.S., and the Professor—now appear for the first time in a

volume of Hope Reports. Mr. H. A. Byatt's estimate of the numerical proportion between a mimetic butterfly hitherto regarded as excessively rare and its abundant model (12) is based on an examination of material I never expected to be fortunate enough to see. Exact observations on the attacks of parasitic insects are always difficult to obtain, and Mr. F. P. Dodd's paper (14) is correspondingly valuable, all the more so because of the description of new species in the Appendix by Col. C. T. Bingham and Dr. Wandolleck. After a long interval of time, Mr. Roland Trimen's association in 1869 of the wonderful series of mimetic females of *Papilio dardanus* (*merope*) with each other and with an entirely different non-mimetic male, receives its absolute confirmation (in 1902–3) by the careful breeding experiments of Mr. G. F. Leigh (11).

Three papers contain the observations of Dr. G. B. Longstaff. The first of these (8), a memoir of over eighty pages, records his notes on butterflies made in a tour through India and Ceylon in 1903 and 1904. It abounds in descriptions of the habits and special localities of these insects, their flight, attitudes, gregarious habits, scents, &c. The symmetrical injuries probably caused by enemies, observations of 'list,' of scents, and of seasonal forms are conveniently summarized at the end of the paper. Dr. Longstaff's second paper (9) gives an account of his observations in 1905 upon the cryptic and mimetic resemblance, as well as the actively defensive methods, of certain South African *Cetoniinae* and *Hopliinae*. His third paper (10) contains a further account of the rest-attitudes of butterflies,—'heliotropism,' 'inverted attitude of Lycaenids,' 'tilt to one side or "list",' and general remarks.

Major Neville Manders contributes material which throws light on two most difficult questions,—the seasonal changes

of the *Pierinae* and the migrations of butterflies (7). The valuable paper on the ants, wasps, and bees of Majorca and Spain (13), by Mr. Edward Saunders, F.R.S., has been already referred to. Mr. Abbott H. Thayer, who originated the classical interpretation of the white under-sides of animals, contributes a most interesting memoir (5) on Protective Coloration. His conclusions, mainly accepted, are in certain respects criticized by the Professor (6).

A communication by the Professor to the Entomological Society of France attempts to explain the meaning of the eye-like spots on the wings of Satyrine and Nymphaline butterflies (1).

A special characteristic of the present volume is the large collection of short communications, almost exclusively upon bionomic subjects, from the 'Proceedings of the Entomological Society of London,' from October 7, 1903, to March 21, 1906. The whole forms a list of exhibitions, notes, discussions, and short papers contained in Nos. 15–21 inclusive of the present volume. It is hoped that all will be easily traced under sufficiently descriptive titles, eighty-nine in number, arranged in order of date, in the Table of Contents.

Dr. Dixey's name appears as the author of considerably over a dozen communications, including accounts of his and Dr. Longstaff's highly important observations on the scents of butterflies, and of his own researches into seasonal forms and cryptic and mimetic coloration in certain *Pierinae*. Dr. Longstaff presented five communications, principally dealing with the attitudes of insects and their bionomic significance, but also including valuable observations on the scents of male butterflies of the Pierine genus *Gonepteryx*. Interesting observations made by Mr. A. H. Hamm were the subject of communications and

exhibitions on five occasions. Five communications also appear under the authorship of Commander J. J. Walker.

A specially interesting feature in the long list printed in the Contents is the constant recurrence of the names of naturalists in other lands as the authors of communications. Thus the observations of Mr. S. A. Neave were made in North-Eastern Rhodesia, Mr. C. N. Barker and Mr. G. F. Leigh in Natal, Dr. S. Schönland in British Bechuanaland, Mr. C. A. Wiggins in British East Africa and Uganda, while Mr. H. A. Byatt dealt with material from the sources of the Congo. It is also a great pleasure to welcome communications from naturalists of the United States,—Professor W. J. Holland of Pittsburg, Professor Vernon L. Kellog of California, and Mr. Abbott H. Thayer of New Hampshire. Mr. J. C. Kershaw's observations were made in the neighbourhood of Macao and Hong Kong, Mr. F. P. Dodd's in North Queensland, Major Neville Manders' in Ceylon, Mr. L. Andrewes' in Southern India.

Finally, a full account of the progress of the Hope Department during the years 1903, 1904, and 1905 will be found in the Reports of the Professor (22–24).

Nearly three years have elapsed since the appearance of the fourth volume of Hope Reports, dated Nov. 9, 1903; but the volume now issued by no means represents the whole of the research in the Department or upon its material. Certain memoirs, published in large octavo or quarto, cannot be accommodated to the size of the present volumes. These larger papers are gradually accumulating until their numbers will admit of a special issue. Several memoirs now going through the press were written within the period covered by volume V. The manuscript for a complete volume on the W. J. Burchell Collections was

all but finished a year ago: but publication has been delayed for a time in the hope that further manuscript bearing on the collections may be discovered (see 21, *b.* 1). When the volume devoted to the memory of Burchell makes its appearance, it will not, like its predecessors, be 'printed for private circulation,' but will be freely accessible to the public.

EDWARD B. POULTON.

HOPE DEPARTMENT OF ZOOLOGY,
UNIVERSITY MUSEUM, OXFORD,
June 25, 1906.

CONTENTS OF VOL. V

Extrait des Annales de la Société Entomologique de France, 1903.

LA SIGNIFICATION BIONOMIQUE DES TACHES OCELLAIRES DES PHASES DE LA SAISON HUMIDE CHEZ LES *SATYRINAE* ET *NYMPHALINAE*

par le Prof. Edward B. Poulton (1).

[Planche VI].

Depuis longtemps on a reconnu que les formes de la saison humide chez les *Satyrinae* sont caractérisées par la quantité et l'apparence distincte des taches ocellaires sur la face inférieure des ailes. Dans la durée de la saison sèche, chez ces mêmes espèces, les taches ocellaires sont très petites ou très souvent absentes. La signification de cette différence et la cause de son origine furent un grand mystère; mais récemment la lumière se fit sur cette question lorsqu'on eut reconnu qu'une différence de même nature existe entre les phases saisonnières de certaines espèces du groupe des *Nymphalidae* (*Precis* ou *Damonia*). Dans la forme de la saison sèche du *Precis artaxia* du Sud Africain, on remarque que la face inférieure des ailes ressemble à une feuille morte d'une manière remarquable. D'autre part, la forme de la saison humide présente une marge blanche visible et des taches ocellaires sur la face inférieure. De même chez l'espèce commune orientale, *Precis almana*, les nombreuses et très visibles taches ocellaires de la phase humide (*asteria*) sont réduites à de minuscules points ressemblant aux petites taches noires de moisissures poussant sur la simili feuille morte de la phase sèche. Cette ressemblance entre les *Satyrinae* et les *Nymphalinae* est très importante. Quand les deux formes des espèces de Sous-Familles aussi différentes que les *Satyrinae* et les *Nymphalinae* réagissent de la même manière particulière aux deux saisons, nous pouvons affirmer d'une manière presque certaine que nous sommes en face d'un phénomène d'adaptation. Nous voyons un état de choses dont la raison d'être provient d'un avantage gagné dans la lutte pour la vie.

(1) Ce mémoire est un résumé des principaux points exposés par notre collègue, M. E. Poulton, professeur de Zoologie à l'Université d'Oxford, dans l'intéressante conférence faite par lui à la Séance du 22 avril 1903 (Cf. Bul. Soc. ent. Fr. [1903], p. 160). (*Note du Secrétaire.*)

J'ai récemment discuté la signification des différences saisonnières chez les Nymphalides du genre *Precis* (*Trans. Ent. Soc. Lond.*, 1902, pp. 414-458). Mais plus mûre réflexion sur le sujet, et surtout la conversation que j'ai eue avec le collègue à qui je dois tant, M. le Dr F. A. Dixey M. D. de Wadham College, Oxford, ont eu pour résultat l'addition de nouveaux détails importants à l'interprétation que j'avais donnée l'an dernier. Le contact de deux esprits produit des idées nouvelles à tous deux, comme l'union de deux cellules germinales qui donne naissance à un nouvel être, — être possédant ses qualités propres, — et non un simple intermédiaire entre les parents.

Ici je voudrais attirer votre attention sur le terme *Bionomique* introduit par mon ami le Professeur E. Ray-Lankester comme le mot le plus convenable pour exprimer les rapports entre les organismes vivants. Cette addition importante à notre terminologie décharge le mot Biologie de toute signification, excepté celle du terme général sous lequel sont rangés tous les sujets de Zoologie et de Botanique. C'est dans l'étude bionomique des Insectes que nous pouvons espérer découvrir l'interprétation du développement spécial des taches ocellaires dans les phases de la saison humide.

Certaines observations semblent jeter la lumière sur ce problème :

En 1887, j'ai observé un Lézard étudiant avec un grand intérêt la tache ocellaire placée à la face inférieure de l'aile antérieure du Papillon commun *Coenonympha pamphilus*. Plusieurs fois le Lézard essaya de mordre cette partie de l'aile. En 1899 M. Marshall observa qu'un rapace fit sa première attaque sur les taches ocellaires des ailes postérieures d'un *Papilio demodocus* qui lui avait été offert. M. Marshall a aussi capturé un grand nombre de papillons du Sud Africain qui présentent des déchirures sur les taches ocellaires ou dans leur voisinage. (*Trans. Ent. Soc. Lond.*, 1902, p. 366.)

Le témoignage de tels faits justifie l'opinion que les taches ocellaires sont des marques destinées à attirer l'attention de l'ennemi et à protéger ainsi l'Insecte d'une blessure mortelle. Par conséquent le papillon attaqué aura une chance de plus d'échapper au danger.

Cette interprétation est encore appuyée par la distribution sur les ailes des taches ocellaires de la saison humide. Elles ne sont pas placées près du corps, contrastant sensiblement de cette façon avec beaucoup de marques indicatrices d'un goût nauséabond (warning or aposematic marks), telles que la tache rouge à la base de la face inférieure des ailes chez les Piérides du genre *Delias*, ou chez les *Heliconinae*, ou encore la tache triangulaire d'un brun doré marqué de noir

observée dans une position correspondante chez tant de papillons Africains (*loc. cit.*, p. 488). D'autre part, ces taches ocellaires tendent à se développer à l'apex de l'aile antérieure et à l'angle anal de l'aile postérieure. On les trouve ailleurs placées sur les bords les plus externes des ailes — c'est-à-dire les plus éloignés du corps — ou près de ces bords.

Il y a encore cependant un autre point important dans cette méthode de défense. Sa valeur la plus certaine, et probablement la seule, est durant les courts arrêts entre les vols successifs d'un Insecte, et spécialement au moment où il va se poser. Sans doute l'ennemi guette l'Insecte, mesure de l'œil la place exacte où il va se poser : c'est le moment choisi pour l'attaque. A cet instant précis les taches ocellaires ont probablement leur plus grande importance et utilité; mais aussitôt que l'instant critique est passé, ces taches tendent à devenir dangereuses. Elles attirent maintenant l'attention des ennemis qui n'ont pas vu l'Insecte allant se reposer. Par conséquent nous voyons, chez beaucoup de *Satyrinae,* que cette tache à l'extrémité de l'aile antérieure est exposée pendant quelques secondes après l'arrêt, puis est cachée par l'abaissement des ailes antérieures entre les postérieures. Il s'ensuit que ces taches sur la face inférieure ont beaucoup plus de valeur pour les Papillons qui volent sans cesse, s'arrêtant pour repartir de nouveau pendant de longues heures de soleil, durant leur vie entière. D'autre part ces taches tendent à devenir un danger réel pour les Papillons qui volent moins, et passent beaucoup plus de temps dans l'attitude du repos. Dans ce repos prolongé, excepté pour certaines espèces nauséabondes, la dissimulation la plus complète est la meilleure défense. Durant cet état de repos les taches ocellaires non seulement constituent un danger en attirant l'attention des ennemis, mais elles sont inutiles pour éloigner celle-ci des parties vitales. Le succès de cette méthode dépend de l'état du papillon, s'il est ou non prêt à la fuite; et lorsqu'un ennemi peut attaquer sans cesse, comme ce serait le cas pour l'Insecte plongé dans un profond repos, une semblable défense est naturellement sans valeur.

Mais la saison humide est justement le temps où les Insectes sont le plus nombreux et volent constamment dans chaque rayon de soleil. Tandis que dans la saison sèche ils sont beaucoup plus rares et beaucoup moins visibles. En pleine saison sèche les Papillons ont l'habitude de se cacher, traversant peut-être une sorte de période de repos estival afin d'échapper aux effets de la grande sécheresse. Mais quelle qu'en soit la cause, un tel repos prolongé est beaucoup plus sûr quand la surface des ailes exposée ressemble au milieu environnant, ou bien

à quelque objet particulier dans ce milieu, tel qu'une feuille morte, qui n'intéresse pas les animaux en quête d'Insectes.

Je crois que c'est là le principe dominant qui explique le développement des taches ocellaires dans les phases humides, et leur diminution ou leur disparition dans les phases sèches chez la même espèce. Les habitudes dans la saison humide sont telles que ces taches confèrent aux Papillons un avantage dans la lutte qu'ils ont à soutenir contre les ennemis de cette saison; les habitudes dans la saison sèche sont telles que ces mêmes taches favoriseraient les ennemis de cette époque.

Cette dernière phrase indiquerait d'autres raisons importantes pour les différentes phases saisonnières des Papillons.

En premier lieu les ennemis qui recherchent et attaquent les Insectes en état d'activité se trouvent probablement eux-mêmes dans des conditions différentes pendant les deux saisons. Ces ennemis sont ou agiles à poursuivre un Papillon, ou agiles à fondre sur lui durant un arrêt momentané; ou bien ils se posent et attendent sur les plantes que les Insectes recherchent. Ainsi que je l'ai déjà suggéré, les taches ocellaires sont probablement développées comme moyen de défense contre ces agiles ennemis de la saison humide — Oiseaux ou Lézards actifs. De tels ennemis, surtout les Oiseaux avec leur puissance de vol, ont un grand choix d'Insectes à leur disposition dans la saison humide; par conséquent ils se décideront facilement à abandonner l'attaque sur un Papillon après un premier échec. Pendant la saison sèche la variété d'Insectes est beaucoup plus restreinte, et les Papillons constituent probablement une beaucoup plus grande proportion de la nourriture des insectivores. Les ennemis agiles sont vraisemblablement dans de telles conditions qu'ils poursuivraient sans remords et renouvelleraient sans cesse leur attaque. Une saveur relativement désagréable serait aussi moins puissante à prévenir leur attaque. C'est probablement une des raisons pour lesquelles les faces inférieures des ailes chez certaines autres espèces du genre *Precis* (*P. sesamus*, *P. antilope*, *P. actia*) sont, non ocellées, mais remarquablement visibles pendant la saison humide, tandis qu'elles sont bien dissimulées dans la saison sèche.

En second lieu, les ennemis qui attaquent les Papillons durant leur repos prolongé comprennent beaucoup d'espèces dont les habitudes et les manières de rechercher leur proie, diffèrent entièrement de celles des espèces qui poursuivent les Insectes actifs. Ces insectivores recherchent soigneusement, systématiquement, chassent partout où ils peuvent espérer trouver quelque nourriture. Ils sont sans doute moins exigeants dans leurs préférences que les ennemis agiles à la poursuite.

et ne sont probablement pas repoussés par un goût modérément nauséabond.

Par conséquent, à cause du ralentissement de leur activité et du temps plus long qu'ils passent en un profond repos, les papillons de la saison sèche sont plus exposés aux attaques de ces ennemis. Ces derniers seraient aidés dans leur recherche par la présence de taches ocellaires ou par toute autre marque visible, et, contre eux, une saveur modérément nauséabonde ne constituerait qu'une défense insuffisante.

Les considérations exposées dans ce mémoire indiquent la raison pour laquelle la sélection naturelle a saisi et développé une sensibilité spéciale pour une condition quelconque associée à l'une ou à deux de ces saisons. La nature exacte de la condition a été insuffisamment étudiée, mais c'est probablement le degré variable d'humidité qui agit comme stimulant sur les espèces rendues particulièrement susceptibles par la sélection naturelle. La susceptibilité est probablement limitée à quelque époque spéciale de leur vie. Par conséquent, comme le colonel J.-W. Yerbury l'a observé à Aden (*Proc. Ent. Soc. Lond.*, 1902, mars 19) la chute soudaine d'une pluie abondante au milieu d'une saison sèche normale est suivie par l'apparition à la fois de formes humides, intermédiaires, et sèches de *Pierinae*. Ce fait s'explique facilement, comme l'a suggéré M. le Dr F.-A. Dixey (*Trans. Ent. Soc. Lond.*, 1903, p. 158-160) par l'hypothèse que, à l'arrivée de la pluie, quelques-uns des individus étaient à leur époque la plus sensible, d'autres n'étaient que partiellement sensibles, tandis que le reste avait déjà cessé d'être sensible.

Si l'on compare la figure 1 sur la planche VI avec la figure 2, on verra que la forme sèche du *Precis artaxia* est beaucoup plus large que la forme humide. Le poids est aussi beaucoup plus grand chez cette espèce et chez d'autres espèces du genre *Precis* (*Trans. Ent. Soc. Lond.*, 1902, p. 451 et 454). Il s'ensuit que dans ces cas, du moins, la période sensible ne peut pas être plus tardive que l'époque larvaire, alors que le poids de l'insecte est déterminé.

Il est probable que la rapidité plus grande du développement pendant la saison humide, entraînant une diminution dans la taille et dans le poids du Papillon, est aussi un avantage conféré par la sélection naturelle. Le nombre des individus chez plusieurs espèces est sans doute relativement abaissé dans la lutte excessive pour la vie pendant la saison sèche, alors que l'occasion de compenser les pertes par une rapide succession de générations n'existe pas. Il est par conséquent avantageux pour les espèces de s'accroître aussi rapidement que possible pendant

le temps où la nourriture est abondante et la lutte moins âpre. Une semblable multiplication est réalisée par le nombre de générations rendu possible par un rapide développement et une diminution dans la taille.

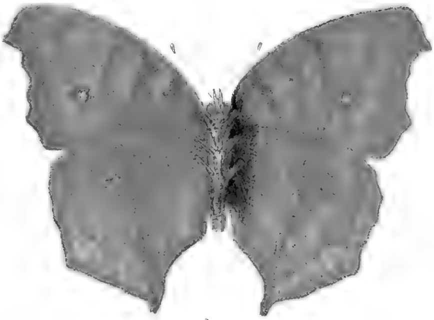
Remarquez de plus que, chez le *Precis artaxia* des forêts profondes, la condition qui agit comme stimulant dans la saison humide n'existe pas (*Trans. Ent. Soc. Lond.*, 1902, p. 423), car là, la phase sèche seule est connue à toutes les époques de l'année. Nous sommes par conséquent conduits à l'hypothèse que le stimulant initiateur des changements aboutissant à un Papillon de la phase humide, peut être fourni par l'eau déposée sur les feuilles de la plante nourricière. La larve a pu ainsi l'avaler avec sa nourriture. Il est possible aussi que l'humidité contenue dans les jeunes feuilles et les pousses qui ont crû activement après la pluie agisse comme stimulant. Donc l'humidité sous une forme ou une autre est la seule condition associée à la saison humide que nous puissions concevoir comme absente ou relativement réduite sous l'ombre des forêts profondes. Je pense qu'il est par conséquent probable que dans l'*Artaxia*, — et s'il en est ainsi chez cette espèce, il en sera de même pour beaucoup d'autres — l'eau avalée avec la nourriture est le point de départ d'une combinaison de changements complexes. Ces derniers occasionnent une accélération dans le développement de l'animal et la production d'un Papillon beaucoup plus petit et plus léger. De fait ils produisent un insecte présentant tous les détails de forme, couleur et dessins caractéristiques de la phase humide.

Ceci n'est qu'une simple suggestion, mais je suis persuadé qu'elle peut induire les naturalistes à même d'étudier sur les lieux, à entreprendre des expériences pour confirmer ou renverser cette hypothèse.

Si les naturalistes peuvent être ainsi amenés à observer, à penser et à expérimenter, nos spéculations seront abondamment justifiées, même si elles se trouvent détruites par le mouvement critique qu'elles auront soulevé.

Je ne puis conclure sans remercier vivement mon amie M^lle^ Petitjean pour son obligeance et les nombreux services qu'elle m'a rendus en mettant ce bref mémoire en état d'être publié. Si j'ai obtenu quelque succès en exposant mes idées en langue française, je le dois presque entièrement à son aide.

TYPOGRAPHIE FIRMIN-DIDOT ET C^ie^. — PARIS.



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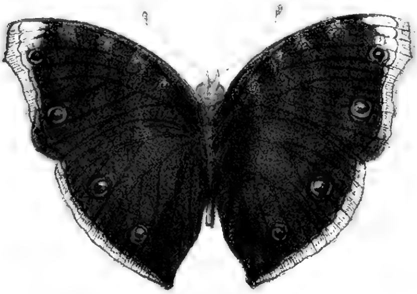

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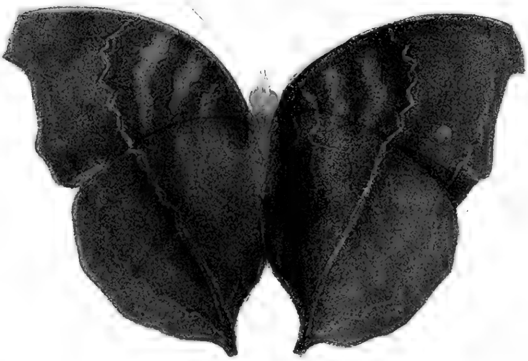

4

assas, pinx. et sculps

I Hew

Lépidoptères de l'Afrique australe et de l'Inde.

1. Precis almana L. .... (saison humide.)
2. .... saison sèche,

3. Precis artaxia .... (saison humid.
4.

THE PRESIDENT'S ADDRESS.

AN ADDRESS

ENTITLED

"WHAT IS A SPECIES?"

READ BEFORE THE

ENTOMOLOGICAL SOCIETY OF LONDON

AT THE

ANNUAL MEETING

ON THE

20TH JANUARY, 1904.

BY

PROF. EDWARD B. POULTON, D.SC., M.A.,
HON. LL.D. PRINCETON, F.R.S.,
HOPE PROFESSOR OF ZOOLOGY IN THE UNIVERSITY OF OXFORD,
FELLOW OF JESUS COLLEGE, OXFORD,

President of the Society.

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THE PRESIDENT'S ADDRESS.

GENTLEMEN,

It is a great pleasure to congratulate the Society at the close of another successful year. The repetition of this congratulation in successive Annual Addresses is happily almost monotonous. It is a monotony which will never weary us, and in itself an indication that no other monotony has prevailed.

The meetings have been well attended, there have been numerous, varied, and interesting exhibits leading to animated discussions. Our Transactions do not reach the phenomenal dimensions attained in 1902, but still form a noble volume, containing 23 plates and well over 600 pages. There is a pleasing variety in the papers, and the domination of the Lepidoptera is less pronounced than usual. An important share of the space is occupied by memoirs on the Coleoptera, Hymenoptera, and Insect Bionomics, while the Diptera and Rhynchota are also represented.

I should wish to refer again to the warmth of the greeting received as your President at a meeting of the Entomological Society of France on April 22nd. The cordial friendship between the followers of science in all lands is of happy augury for the advancement of the researches in which we find common aims and mutual sympathy and respect.

On this, the first occasion on which I have the honour of addressing you formally, I cannot resist the temptation of calling attention to a remarkable coincidence of a personal nature—the fact that the present occupant of this Chair and his immediate predecessor should be members not only of the same University, but of the same College, and that not a large one. When this fact was explained to a friend he said it was easily understood, because the study of natural history is infectious. This suggestion, plausible as it is, fails to account for the fact; inasmuch as Canon Fowler left Jesus College,

Oxford, in June 1873, while I did not matriculate until October of the same year, so that, as undergraduates, we never saw each other.

Before speaking of the losses which have fallen so heavily upon our community during 1903,—the brother Fellows who have gone from our midst, I feel bound to allude to the grief which we share with the whole intellectual world at the passing away, towards the close of the old year, of the great thinker to whom we owe far more than we can realise. I well remember the sudden access of light received when, between the age of seventeen and eighteen, Herbert Spencer's works were first placed in my hands. The whole of science seemed illuminated, the whole outlook broadened. It was the most sudden and by far the greatest intellectual awakening I have ever experienced. And, as we know well, it has been the same with thousands. After Shakespeare, no man has done more to bring together the English* of the Old World and the New. And not only among ourselves, but everywhere in the civilised world the writings of Herbert Spencer have stirred enthusiasm and compelled admiration. They have left strong, indelible, beneficent after-effects even in those who are unable to believe in the enduring stability of the Synthetic Philosophy—a fabric as fair and stately as any created by the mind of man.

Since the above paragraph was written Mr. Herbert Spencer's will has been made known in the *Times* for January 14th. I am sure that every Fellow of our Society keenly appreciates the expression of confidence which is implied in the gift which will hereafter be offered to us by the Trustees of the will—a gift which we shall regard as a solemn trust, to be so carried out as to secure the greatest possible advantage to the science we serve.

Frederick Bates, F.E.S., joined the Society as a "subscriber" in 1867. Subsequently withdrawing, he again entered the Society as a Fellow in 1897. He was born at Leicester in 1829, and his death occurred at Chiswick on the 6th of October, in his 74th year. Like his distinguished

* For the justification of this use of the word see Sir Michael Foster's Presidential Address to Section D of the British Association at Toronto (Report for 1897).

brother, H. W. Bates, F.R.S., he was especially devoted to the Coleoptera, although his interests were wide and embraced many aspects of natural history, both zoological and botanical. He was the author of many papers, chiefly dealing with the Heteromera, in our Transactions and in the "Entomologist's Monthly Magazine." His exceedingly fine collection of Heteromera is now in the British Museum, while his collection of British Coleoptera was a gift to his intimate friend Mr. Horace Donisthorpe. Many friends mourn the loss of a keen and able naturalist, a many-sided and genial personality.*

The Rev. John Hocking Hocking, M.A., J.P., F.E.S., Rector of Copdock-with-Washbrook, near Ipswich, was elected a Fellow in 1896. His death occurred on the 10th of December last, at the age of 69. He was an ardent collector of the Lepidoptera, but having only recently joined the Society was unfortunately known to but few of the Fellows.†

The Rev. Thomas Ansell Marshall, M.A., F.E.S., joined the Society in 1865. By his death on April 11, 1903, at Ajaccio, one of the few authorities upon the parasitic Hymenoptera is lost to science. Mr. Marshall was born at Keswick on March 18, 1827, the son of Thomas Marshall, an original member of the Entomological Society. He took a scholarship at Trinity College, Oxford, and passed through the Classical Honours course. With great powers as a linguist, and a student of Hebrew and Sanskrit, he worked for a time on the staff of the British Museum Library. Subsequently he took Holy Orders, and after engaging in scholastic work, held livings in various parts of England, interrupted only by his appointment as Bishop's chaplain in Antigua. In this island he was bereft of his wife, and was himself in serious danger from an attack of fever. Upon his return to England he was presented, in 1889, to the living of Botus Fleming, Cornwall, which he retained until 1897, when he retired to Corsica, and devoted the remainder of his life to his favourite science. T. A. Marshall's earliest important work dealt with the Coleoptera (Journ. Linn. Soc. 1865). The first of the series of memoirs

* See the Obituary notice in the "Entomologist's Record," vol. xv, No. 12, by Horace Donisthorpe; and that in the "Entomologist's Monthly Magazine," Nov. 1903, p. 286.

† See also the Obituary notice in the "Entomologist's Monthly Magazine" for Jan. 1904, p. 19.

by which his name will be chiefly known was published in 1870, "Ichneumonidum Britannicorum Catalogus," followed by the valuable monographs on the British Parasitic Hymenoptera, which appeared in the Transactions of this Society between 1872 and 1889. He published an important volume on a portion of the *Braconidæ* in André's "Species des Hyménoptères d'Europe," and was still at work on the subject at the time of his death. He was an accomplished draughtsman and a clear and admirable writer. The loss of so able a student of an important but much-neglected group will be long and deeply deplored.*

Philip Brookes Mason, M.R.C.S., F.L.S., F.E.S., a Fellow of our Society since 1874, died on November 6, 1903, at Burton-on-Trent. His death is a sad loss to his profession, to the neighbourhood in which he laboured, and to a wide circle of naturalist friends. Mr. Mason was born at Burton on January 2, 1842. After a medical education of unusual distinction and variety of valuable experience, he made his permanent home at his native town in the Midlands. The British fauna and flora formed the chief interest of his life, and he possessed magnificent collections of both. With his sympathetic genial nature, it was his delight to welcome his brother naturalists to share in the well-nigh unique advantages which he possessed. And as he was a skilled and honoured member of the healing profession, so he was ever ready to lend the weight of his influence and the power of his persuasion to promote peace and friendliness. As the Society concerned with the branch of natural history to which he was chiefly devoted, we recognise, with grief, that a strong influence for good has passed from us.†

John Sanders Stevens, F.E.S., became a Fellow in 1862. His death at Woking, on July 15, makes a sad break in the ranks of the senior Fellows of the Society.‡

* See also the Obituary notice in the "Entomologist's Monthly Magazine," June 1903, p. 152, by R. McLachlan, F.R.S.; and that in the "Entomologist's Record," vol. xv, No. 7, p. 190, by G. C. Bignell.

† See also the Obituary notice in the "Entomologist's Monthly Magazine," Jan. 1904, pp. 17, 18, by the Rev. Canon W. W. Fowler; also "The Lancet" for Nov. 13, 1903.

‡ See also the Obituary notice in the "Entomologist's Monthly Magazine," Sept. 1903, p. 229.

Outside the number of our own Fellows, we miss four well-known names from the ranks of British entomologists :—WILLIAM DUPPA CROTCH, M.A., F.L.S., a keen student of the Lepidoptera, Coleoptera and Hemiptera; EDWARD ROBERT DALE, son of the eminent J. C. Dale, and himself an eager entomologist in his younger days; THE VERY REV. CANON BERNARD SMITH of Great Marlow, an enthusiastic collector and breeder of the British Lepidoptera; SAMUEL JAMES WILKINSON, author of the celebrated "British Tortrices," published in 1859.

We sympathise deeply with our brethren on the continent in their grief for the eminent men who have passed away in 1903 :—JOHANNES FAUST, the eminent authority upon the *Curculionidæ*, whose collection contained over 13,000 species, of which more than 2000 were described by himself; PROFESSOR AUGUSTUS RADCLIFFE GROTE, A.M., the celebrated student of the Lepidoptera.

"WHAT IS A SPECIES?"

The late Professor Max Müller, in an eloquent speech delivered at Reading in 1891, spoke of the necessity of examining, and, as time passes by, re-examining the meaning of words. He referred as an illustration to the man at the railway station who taps the wheels with his hammer, testing whether each still rings true or has undergone some change that may mean disaster. In almost the same way, the speaker maintained, a word may slowly and unobtrusively change its meaning, becoming, unless critically tested to ascertain whether it still rings true, a danger instead of an aid to clear thinking, a pitfall on the field of controversy. He then went on to say, that Darwin had written a great work upon the Origin of Species, and had never once explained what he meant by the word Species. So decided an utterance—the statement was made emphatically—ought to have involved a careful and critical search through the pages of the work that was attacked. However this may be, it is quite certain that the search was unsuccessful; and yet a few minutes' investigation brought me to a passage in which the meaning attached by the author to the term Species is set

down in the clear, calm, and simple language which did so much to convince an unwilling world.

Darwin is speaking of the revolution which the acceptance of his views will bring about. " Systematists will be able to pursue their labours as at present; but they will not be incessantly haunted by the shadowy doubt whether this or that form be in essence a species. This, I feel sure, and I speak after experience, will be no slight relief. The endless disputes whether or not some fifty species of British brambles are true species will cease. *Systematists will have only to decide (not that this will be easy) whether any form be sufficiently constant and distinct from other forms to be capable of definition, and if definable, whether the differences be sufficiently important to deserve a specific name.* This latter point will become a far more essential consideration than it is at present; for differences, however slight, between any two forms, if not blended by intermediate gradations, are looked at by most naturalists as sufficient to raise both forms to the rank of species. *Hereafter we shall be compelled to acknowledge that the only distinction between species and well-marked varieties is, that the latter are known, or believed, to be connected at the present day by intermediate gradations, whereas species were formerly thus connected.* Hence, without quite rejecting the consideration of the present existence of intermediate gradations between any two forms, we shall be led to weigh more carefully, and to value higher, the actual amount of difference between them. It is quite possible that forms now generally acknowledged to be merely varieties may hereafter be thought worthy of specific names, as with the primrose and cowslip; and in this case scientific and common language will come into accordance. In short, we shall have to treat species in the same manner as those naturalists treat genera, who admit that genera are merely artificial combinations made for convenience. This may not be a cheering prospect, but we shall at least be freed from the vain search for the undiscovered and undiscoverable essence of the term species." I have quoted from pages 484, 485 of the original edition (1859), and have italicised the sentences in which Darwin defines a species and distinguishes it from a variety.

Max Müller's special criticism falls to the ground, but his general exhortation remains, and I think we shall do well to be guided by it, and attempt to apply it to this difficult and elusive word SPECIES.

The passage I have quoted was Darwin's prediction of the meaning which would be attached to the word "species" by the naturalist of the future. Nearly half-a-century has passed since those words were written. For more than a generation the central ideas of the "Origin" have been an essential part of the intellectual equipment, not only of every naturalist, but of every moderately intelligent man. What then is the meaning of the word "species" to-day, and how does it differ from that of the years before July 1, 1858, when the Darwin-Wallace conception of natural selection was first launched upon the world?

The present occasion is especially favourable for this inquiry, because we have just been given two additional volumes of the letters of Charles Darwin. After the three volumes published in 1887, naturalists were certainly unprepared for the welcome revelation of such a mine of wealth. The work is all the more valuable because it contains many letters from Alfred Russel Wallace and Sir Joseph Hooker, thus giving both sides of a part of their correspondence with Darwin. Then in 1900 the "Life and Letters of Thomas Henry Huxley" appeared, so that we are now admitted "behind the veil," and can read, as never before, the central thoughts of the great makers of biological history. On the publication of the last-named work, I took occasion to combat the view that the thousand closely-printed pages might have been reduced by omitting and condensing many of the letters. The serious student of those stirring years requires the opportunity of thinking over and comparing all the available thoughts and opinions of the chief actors in the memorable scene; and the very repetition of certain ideas, which proves their persistence and dominance in the writer's mind, is a matter of deep importance and interest. However it may be to the general reader, the student would deprecate the omission or condensation of any of the writings of Darwin or Huxley. The special interest and value in the letters of these men depend on the

fact that their inmost convictions on matters of the deepest scientific importance are to be read, often in the compass of a brief sentence. There we find, as we cannot find in any other way, the real core of the matter, with all accessory and surrounding considerations stripped away from it.* A careful study of the two recent volumes of Darwin's letters, and a re-study of the three earlier volumes, with a view to this Address, have shown how Darwin's thoughts were again and again occupied upon subjects bound up with the problem I have ventured to bring before you this evening. The interest reaches its height when we find that strongly-marked differences of opinion on fundamental questions are threshed out in the correspondence, when we see, as I shall have occasion to point out in greater detail in the later pages of this Address, Darwin differing sharply from Huxley on the one hand, and with Wallace on the other, as to the significance and history of sterility between species.

In such episodes we are permitted to become the witnesses of a supremely interesting struggle, where the central figure of modern biological inquiry is contending with his chief comrades in the great fight,—with the co-discoverer of natural selection, with the warrior hero who stood in the forefront of the battle.

The correspondence of Charles Darwin has a further deep interest for us. We see the means by which a gentle, sympathetic, intensely human nature overpassed the stern limits imposed by health, and was able to impart and to receive fresh ideas, and a stimulus ever renewed—the impulse to varied and unceasing research. I have lately been studying with keen interest the life of another great Englishman, William John Burchell,† than whom no better equipped or more learned traveller ever explored large areas in two continents. When I state that searching inquiry has only brought to light a dozen of his letters, and that he was known to hardly any of the great naturalists of his day, we see the reason for the sad, unproductive, brooding close of a career which opened with almost unexampled brilliancy and

* "Quarterly Review," January 1901, p. 258.
† "Ann. and Mag. Nat. Hist.," January 1904, p. 45.

promise. The time which we give to Societies such as this—time we are sometimes apt to grudge—is well spent. Here, and in kindred communities, a "man sharpeneth the countenance of his friend," and there is born of the influence of mind upon mind thought which is not a mere resultant of diverse forces, but a new creation.

The scientific man who shuts himself away from his fellow-men, in the belief that he is thereby obtaining conditions the most favourable for research, is grievously mistaken. Man, scientific man perhaps more inevitably than others, is a social animal, and the contrast between the lives of Darwin and Burchell shows us that friendly sympathy with our brother naturalists is an essential element in successful and continued investigation.

I do not suppose that it is necessary to justify a discussion of the term "species" as the subject of the Anniversary Address to the Entomological Society of London. The students of insect form and function hold an exalted place among naturalists. The material of their researches enables them, almost compels them, to take the keenest and most active interest in broad questions affecting the history and course of life on our planet. Naturalists engaged upon other groups may reasonably inquire why *insects*, above all other animals, should be so especially valuable for the elucidation of the larger problems which deal, not only with the species of a single group, but with every one of the innumerable and infinitely varied forms, vegetable no less than animal, in which life manifests itself. The answer is to be found in the large number of offspring produced by each pair of insects, and the rapidity with which the generations succeed each other, many cycles being completed in a single year in warm countries; in the severity of the struggle for life which prevents this remarkable rate of multiplication from becoming the cause of any progressive increase in the number of individuals; and finally, in the character of the struggle itself, which is precisely of that highly specialised kind between the keen senses and activities of enemies, and the means of concealment or other modes of defence of their insect prey, which leads, by action and answering reaction, to

a progressive raising of the standard in both pursuer and pursued. This is why it is that insects mean so much to the naturalist or to the philosopher who desires to look beneath the surface for the forces which have moulded existing forms of life out of earlier and very different forms. The wings of butterflies, it has been said, serve as a tablet on which Nature writes the story of the modification of species.* But the careful study of insects tells us even more than this; for it gives us the clearest insight we as yet possess into the forces by which these changes have been brought about. Light is thrown upon the causes to which organic evolution is due no less than upon the course which organic evolution has pursued.†

And I think we shall find that a consideration of the numerous distinct categories of forms presented by the insect world is especially advantageous in an attack upon the difficult question—"What is a species?", while properly-directed observation of insects, and experiments upon insects afford the most hopeful prospect of a final answer.

And here I am compelled to say a word in defence of the Lepidoptera from this point of view. Undoubtedly it is most unfortunate that the obvious attractions of the group have led entomologists to neglect other Orders; for this can be the only explanation why naturalists have so often preferred to do over again what others have done already, apparently oblivious of fields comparatively empty and unexplored. It must further be admitted, that the greater visibility of structure, and the more urgent necessity for the study of structure in other groups, render them better instruments of zoological education. But although the Lepidoptera are inferior in this respect, although they lack the unique interest of the Hymenoptera and the social Neuroptera, and cannot claim any of the respect due to venerable age like the Aptera, Orthoptera and Neuroptera—in spite of their many demerits they stand at the head, not only of all insects, but

* H. W. Bates, quoted by A. R. Wallace in "Natural Selection," London, 1875, p. 132. The original passage may be found in "The Naturalist on the Amazons" (London, pp. 347, 348 of the 1879 edition).

† This justification for the study of insects was urged by the present writer in the Hope Reports, vol. iii, 1903, preface, pp. 4, 5.

of the whole organic world, as the registers of subtle and elusive change—ever going on, yet never seen,—by means of which forms are slowly becoming different from what they have been in the past. It is the existence of a complex pattern composed of several colours, which renders butterflies and to a less extent moths such a remarkably delicate record of change. As we trace the representative individuals of a community of butterflies over any wide range, the trained eye, and often the inexperienced eye, can detect differences which are not seen to anything like the same extent in the individuals of other Orders with corresponding ranges. If the wings of Hymenoptera, Diptera, or Orthoptera possessed the same elaborate patterns as the Lepidoptera, we cannot doubt that they too would exhibit the same differences in various parts of their areas. These continual changes which we find as we study the distribution of Lepidopterous forms in space, is undoubtedly a measure of the speed with which they have occurred in time. Rapidity of change is essential if it is to keep its adjustment with nicety to the fleeting details of distribution.* Hence we may confidently believe, that if we

* It is to be observed that I speak of the *details* as fleeting. The *general* area of distribution is doubtless extremely ancient in most cases. Thus, although a species of *Heliconius*, etc., may have originated within the South American tropics, and never have wandered beyond them, the complex shape of its actual area of distribution at any one time cannot be regarded as fixed or ancient. Yet in many a species the variation of the constituent individuals is adjusted with precision to the geographical details of the existing range.

Mr. Roland Trimen, on reading the above footnote, writes to me January 24, 1904:—"Your note reminds me of the recent appearance on the Natal coast of several conspicuous East-African butterflies, *vid.: Pieris spilleri, Crenis rosa*, and *Godartia wakefieldii*, all of which are shown to have not only extended their range to a point where they were previously quite unknown, but to have also *established* themselves in the fresh area. This is a good case, as Durban has had, for the last twenty-five years at least, a number of keen collectors of Lepidoptera, whom such conspicuous forms could not possibly have escaped had they inhabited the neighbourhood. Besides these species, the last butterfly that my friend and collaborator, the late Colonel Bowker, sent to me (1898) was the large and extremely conspicuous black-and-white *Acræa satis*, which he took at Malvern, near Durban. This is the only example known to me to have occurred in Natal; but Bowker, who noted the resemblance on the wing to *Papilio morania*, wrote that he had seen one other for certain, and thought that he might very possibly have passed over more examples for the common *Papilio* named. This last case is of special interest (should it prove one of extended range like the three mentioned), because the *Acrææ* are so exceptionally slow-flying and gregarious, that they must spread *very* slowly indeed into fresh areas."

could wake up in say a thousand years, we should be able to detect changes in the patterns of some butterflies. Although I am afraid the advance of science is not likely to be sufficiently rapid in our time for me to hold out any prospect of such an experience for any of you, there is every reason why we should afford this opportunity to posterity. A critical examination of the fragments of many species of butterflies captured ninety years ago by Burchell in S. Africa, and gnawed to pieces during his Brazilian travels from 1825 to 1830, renders it probable, nay, almost certain, that with moderate care, insect pigments will endure for an indefinite period in our museums. One important justification for the great and permanent outlay required to bring together and maintain large collections of insects is, that we are allowing our successors the chance of detecting and measuring the rate of specific change.* And, as I have already said, for this purpose the Lepidoptera stand pre-eminent.

For the purpose of the inquiry this evening, our instances will be drawn from the Lepidoptera rather than other Orders of insects, because of the numberless examples of subtle distinction between forms which but yesterday, so to speak, became separate; because of our knowledge, insufficient but considerable, of their geographical ranges; because of our experience, excessively imperfect and scanty, but still much larger than in other Orders, of inter-breeding and of descent from parent to offspring.

First among the attempts to define species must be placed that which we rightly associate with the name of Linnæus.

It has been admirably pointed out by the late Rev. Aubrey L. Moore,† that the dogma of the fixity of species is entitled to none of the respect which is due to age. "It is hardly credible to us," he wrote, "that Lord Bacon, 'the father of

* Karl Jordan argues with great force in favour of specialisation in this direction by our museums. (See "Novitates Zoologicæ," vol. iii, December 1896, pp. 431–433.) The Burchell collection from Brazil is only seventy-four to seventy-nine years old, but the species are numerous, and often represented by long series. An account of the butterflies by Miss Cora B. Sanders will shortly appear in the "Annals and Magazine of Natural History"; and it will then be seen that the evidence of change in certain forms is by no means wanting.

† "Science and the Faith," London, 1889, pp. 174 *et seq.*

modern science' as he is called, though he was only a schoolman touched with empiricism, believed not only that one species might pass into another, but that it was a matter of chance what the transmutation would be. Sometimes the mediæval notion of vivification from putrefaction is appealed to, as where he explains the reason why oak boughs put into the earth send forth wild vines, 'which, if it be true (no doubt),' he says,* 'it is not the oak that turneth into a vine, but the oak bough, putrefying, qualifieth the earth to put forth a vine of itself.' Sometimes he suggests a reason which implies a kind of law, as when he thinks that the stump of a beech tree when cut down will 'put forth birch,' because it is a 'tree of a smaller kind which needeth less nourishment.'† Elsewhere he suggests the experiment of polling a willow to see what it will turn into, he himself having seen one which had a bracken fern growing out of it! ‡ And he takes it as probable, though it is *inter magnalia naturæ*, that 'whatever creature having life is generated without seed, that creature will change out of one species into another.' Bacon looks upon the seed as a restraining power, limiting a variation which, in spontaneous generations, is practically infinite, 'for it is the seed, and the nature of it, which locketh and boundeth in the creature that it doth not expatiate.'" And the author also shows that much earlier than the date at which Bacon wrote, theologians were by no means unanimous in accepting "special creation"; that St. Augustine even distinctly rejected it, and propounded an idea which was evidently considered tenable by the greatest of the schoolmen, St. Thomas Aquinas. St. Thomas' words, quoted by Mr. Aubrey Moore, are as follows:—"As to the production of plants, Augustine holds a different view. For some expositors say that, on this third day (of creation), plants were actually produced each in his kind—a view which is favoured by a superficial reading of the letter of Scripture. But Augustine says that the earth is then said to have brought forth grass and trees *causaliter*—*i. e.* it then received the power to produce them." §

* "Nat. Hist." *Cent.* vi, 522, fol. ed.

† *l. c.* p. 523.

‡ *l. c.* p. 112.

§ St. Thomas Aquinas, "Summa Theol." Prima Pars. Quaest., lxix, Art. 2.

How then did the fixity of species become an article of belief in later years? Aubrey Moore traces it to the influence of Milton's account of creation in the seventh book of "Paradise Lost" (l. 414, *et seq.*), and Professor Huxley had still earlier suggested the same cause in his "American Addresses." I cannot help thinking that the belief had even more to do with the spirit of the age which spoke, and spoke for all time, with Milton for its interpreter,—the spirit of the Puritan movement, with its insistence on literal interpretation and verbal inspiration.

John Ray was Milton's younger contemporary, and many writers, including Aubrey Moore, have thought that with him began the idea of the fixity of species. Sir William Thiselton Dyer has, however, recently pointed out, that a conception similar to Ray's may be traced to Kaspar Bauhin (1550–1624) and to Jung (1587–1657).*

From Ray we pass to Linnæus with his often quoted definition, "Species tot sunt, quot diversas formas ab initio produxit Infinitum Ens, quae formae, secundum generationis inditas leges produxere plures, at sibi semper similes." Of the Ray-Linnæus-Cuvier conception of species which found its most precise and authoritative expression in the above-quoted latin sentence, Dr. F. A. Dixey has well said that it "left order where it found confusion, but in substituting exactness of definition for the vague conceptions of a former age, it did much to obscure the rudimentary notions of organic evolution which had influenced naturalists and philosophers from Aristotle downwards." † At the same time it is by no means improbable, as Dixey has suggested, that the Linnean conception "of the reality and fixity of species perhaps marks a necessary stage in the progress of scientific enquiry." ‡

The Linnean idea of special creation has no place in the realm of science; it is a theological dogma. The formation of species, said Darwin in a letter to Lyell, "has hitherto been viewed as beyond law; in fact, this branch of science

* "The Edinburgh Review," Oct. 1902, p. 370.

† "Nature," June 19, 1902, p. 169. For the history of these early ideas upon evolution see "From the Greeks to Darwin," by H. F. Osborn, New York, 1894.

‡ "Church Quarterly Review," Oct. 1902, Art. II p. 28.

is still with most people under its theological phase of development." * And this explains the intense opposition at first encountered by the principles of the "Origin." The naturalist whose genius sympathised most fully with the Linnean conception would feel that he was admitted, like a seer of old, into the presence of the Maker of the Universe. His convictions as to species were to him more than the conclusions of the naturalist; they were a revelation, stirring him to "break forth and prophesy." Do we not sometimes recognise a lingering trace of this phase of thought in the serious shake of the head and tone of profound inner conviction with which we are sometimes told that the speaker is decidedly of the opinion that so-and-so is a perfectly good species?

We recognise the same sharp antagonism between two irreconcilable sets of ideas when the late W. C. Hewitson expressed such horror at Roland Trimen's remarkable discovery of the polymorphic mimetic females of the *Papilio merope* group. The wonderfully acute detection of minute but significant resemblance hidden under the widest possible superficial difference, which enabled the great South African naturalist to unravel the tangled relationships, was to Hewitson but one of "the childish guesses of the . . . Darwinian School." To meet the carefully-thought-out argument, the only objections that could be urged were that the conclusion stretched too severely the imagination of the writer, and that it shocked his notion of propriety! †

* Letter 132 to C. Lyell, Aug. 21, 1861. "More Letters of Charles Darwin," London, 1903, i, p. 194.

† See an account of the controversy in Trans. Ent. Soc. Lond., 1874, p. 137. The passages I have alluded to are as follows:—"*P. merope*, of Madagascar, has a female the exact image of itself; and it would require a stretch of the imagination, of which I am incapable, to believe that the *P. merope* of the mainland, having no specific difference, indulges in a whole harem of females, differing as widely from it as any species in the genus. . . . In the two species of *Papilio* which have lately been united, *Torquatus* and *Candius*, and *Argentus* and *Torquatinus*, though much unlike each other, there is quite sufficient resemblance not to shock one's notions of propriety." A little later Mr. Hewitson himself received evidence of the truth of the conclusion he so disliked; for he told how his collector Rogers had sent "*Papilio merope* and *P. hippocoön*, taken by him in copulation, another illustration of the saying that 'truth is stranger than fiction.' I find it very difficult (even with this evidence) to believe that a butterfly, which, when a resident in Madagascar, has a female the image of itself, should, in West Africa, have one without any resemblance to it at all" ("Entomologist's Monthly Magazine," Oct. 1874, p. 113).

In leaving the dogma of "special creation," and the assumption of "fixity of species" with which it is bound up, it is only right to point out how completely the logical foundations of both were undermined by the great thinker who has just passed away. Years before the appearance of the Darwin-Wallace essay, and of the "Origin," Herbert Spencer wrote on "The Development Hypothesis."* Although of course wanting the great motive power to evolution supplied by natural selection, this essay is a powerful and convincing argument for evolution as against special creation. It is astonishing that it did not produce more effect. I may appropriately conclude this section of the Address by quoting the results of Herbert Spencer's critical examination, from every point of view, of the Linnean conception of species. "Thus, however regarded, the hypothesis of special creations turns out to be worthless—worthless by its derivation; worthless in its intrinsic incoherence; worthless as absolutely without evidence; worthless as not supplying an intellectual need; worthless as not satisfying a moral want." †

If then the Linnean conception of species—separately created and fixed for all time at their creation—has been abandoned, what have we to put in its place? In a letter to Hooker, Dec. 24, 1856, Darwin gave a list of the various definitions he had met with. "I have just been comparing definitions of species, and stating briefly how systematic naturalists work out their subjects. . . . It is really laughable to see what different ideas are prominent in various naturalists' minds when they speak of 'species'; in some, resemblance is everything, and descent of little weight—in some, resemblance seems to go for nothing, and creation the reigning idea—in some, descent is the key—in some, sterility an unfailing test, with others it is not worth a farthing. It all comes, I believe, from trying to define the indefinable." ‡

As regards the work done by the systematist, we find that Darwin did not agree with those of his friends who thought

* In the *Leader*, between January 1852 and May 1854, reprinted in "Essays Scientific, Political, and Speculative." London, 1868, vol. i, p. 377.

† "The Principles of Biology." London, 1864, vol. i, p. 345.

‡ "Life and Letters of Charles Darwin," London, 1887, vol. ii, p. 88.

that a belief in evolution would entirely alter its character. Thus he wrote to Hooker, Sept. 25, 1853 :—" In my own work I have not felt conscious that disbelieving in the mere *permanence* of species has made much difference one way or the other; in some few cases (if publishing avowedly on the doctrine of non-permanence) I should *not* have affixed names, and in some few cases should have affixed names to remarkable varieties. Certainly I have felt it humiliating, discussing and doubting, and examining over and over again, when in my own mind the only doubt has been whether the form varied *to-day or yesterday* (not to put too fine a point on it, as Snagsby would say). After describing a set of forms as distinct species, tearing up my MS., and making them one species, tearing that up and making them separate, and then making them one again (which has happened to me), I have gnashed my teeth, cursed species, and asked what sin I had committed to be so punished. But I must confess that perhaps nearly the same thing would have happened to me on any scheme of work." *

The essentially subjective character of the results reached by the systematist stands out with remarkable force in this as in other passages of Darwin's letters.

A few years later, on July 30, 1856, he wrote to the same friend :—" I differ from him [Lyell] greatly in thinking that those who believe that species are *not* fixed will multiply specific names: I know in my own case my most frequent source of doubt was whether others would not think this or that was a God-created Barnacle, and surely deserved a name. Otherwise I should only have thought whether the amount of difference and permanence was sufficient to justify a name." †

Disregarding for the moment the term species, it is convenient to consider the various groupings of individual animals and plants.

1. Forms having certain structural characters in common distinguishing them from the forms of other groups. Groups thus defined by *Diagnosis* may be conveniently called *Syndiagnostic* (σύν, together; διάγνωσις, distinction).

* "Life and Letters," vol. ii, p. 40.
† *Ibid.* vol. ii, p. 81.

2. Forms found together in certain geographical areas and not in other areas. Such groups may be called *Sympatric* (*σύν*, together; *πάτρα*, native country). The occurrence of forms together may be termed *Sympatry*, and the discontinuous distribution of similar forms *Asympatry*.

3. Forms which freely inter-breed together. These may be conveniently called *Syngamic.* (*σύν*, together; *γάμος*, marriage). Free inter-breeding under natural conditions may be termed *Syngamy*; its cessation or absence, *Asyngamy* (equivalent to the *Amixia* of Weismann).

4. Forms which have been shown by human observation to be descended from common ancestors. Such groups may be called *Synepigonic* (*σύν*, together; *ἐπίγονος*, descendant). Breeding from common parents may be spoken of as *Epigony* or the production of *Epigonic* evidence.*

My friend, Professor E. Ray Lankester, to whom I owe so much, in this as in many other subjects, is inclined to think that we should discard the word species not merely momentarily but altogether. Modern zoology having abandoned Linnæus' conception of "species" should, he considers, abandon the use of the word. In his opinion the "origin" of species was really the abolition of species, and zoologists should now be content to describe, name, draw, and catalogue *forms.* Furthermore, the various groups of forms briefly defined above should be separately and distinctly treated by the zoologist, without confusion or inference from one to the other. The systematist should say, "I describe and name certain forms *a*, *b*, etc."; and then he or another may write a separate chapter, as it were:—"I now show that the forms *ab*, *ac*, *ad* (form names) are syngamic:" at another time he may give reason for regarding any of them as related by epigony.

I fear that this suggestion is a "counsel of perfection," impossible of attainment, although there would be many

* My friend Mr. Arthur Sidgwick has kindly helped me by suggesting the appropriate Greek words. The use of *ἐπίγονος* I owe to my friends Mr. Arthur Evans and Mr. R. W. Macan. The adjectival termination is made *-ic* throughout for the sake of convenience, although *Sympatriote* or *Sympatrid* would have been more correct.

and great advantages in thus making a fresh start and in the abandonment of "species," or the restriction of the word to the only meaning it originally possessed before it was borrowed from logic to become a technical term in zoology.*

Professor Lankester in former years published (I cannot at this moment lay my hands upon the communication) the suggestion that the term species should be limited to a group which includes all the forms derived from common ancestors within human experience, or inferred to be so derived within the possible period of human observation. Thus if the common ancestry of two forms has to be traced back to a period beyond the late pre-historic times (or beyond any other arbitrary line which is agreed upon), then they are not members of the same species. Professor Lankester is the first to admit that the practical application of this as of every other conception of species would very often mean a great deal more than we can prove, in fact, hypothesis.

It is evident too that Darwin regarded persistence of form as an important criterion of a species. We recognise this in the definition I have quoted from the "Origin" (see p. 10), and it is stated with even greater force in the following passage, where persistence is placed beside other distinguishing marks of a species and given the pre-eminence. In a letter to Hooker (October 22, 1864) Darwin says:—"I will fight to the death that as primrose and cowslip are different in appearance (not to mention odour, habitat, and range), and as I can now show that, when they cross, the intermediate offspring are sterile like ordinary hybrids, they must be called as good species as a man and a gorilla. The power of remaining for a good long period constant I look at as the essence of a species, combined with an appreciable amount of difference." †

It is now necessary to examine in some detail the most usual conception of a species, a conception based upon distinguishing structural characters, or diagnosis.

This idea of a species is clearly expressed by Sir William Thiselton Dyer, when he speaks of the older writers who

* See F. A. Dixey in "Nature," June 19, 1902, p. 169.

† "More Letters," vol. i, p. 252, Letter 179.

employed "the word species as a designation for the totality of individuals differing from all others by marks or characters which experience showed to be reasonably constant and trustworthy, as is the practice of modern naturalists." *

This conception of a species is founded upon transition. Whenever a set of individuals can be arranged, according to the characters fixed upon by the systematist, in a series without marked breaks, that set is regarded as a species. The two ends of the series may differ immensely, may diverge far more widely than the series itself does from other series; but the gradual transition proclaims it a single species. If transitions were all equally perfect of course there would be no difficulty. But transitions are infinite in their variety; while the subjective element is obviously dominant in the selection of gaps just wide enough to constitute interspecific breaks, just narrow enough to fuse the species separated by some other writer,—dominant also in the choice of the specific characters themselves.† Looking back upon the interval between Linnæus and Darwin, it seems remarkable that the mutability of species was not forced upon systematists as the result of their own labours. It is astonishing that many a naturalist was not driven by his descriptive work to the conclusion which Darwin stated to Asa Gray on July 20, 1856: "— as an honest man, I must tell you that I have come to the heterodox conclusion, that there are no such things as independently created species—that species are only strongly defined varieties." ‡

For, as I have said above, every describer of species made continuity and transition in characters the test of a variety, discontinuity the test of a separate species. And in difficult cases no two of them agreed in their conclusions. Many passages in Darwin's correspondence convincingly prove how essential an element is this continuity, and how inevitable

* *l.c.* p. 370.

† How important this choice may be is well shown by Karl Jordan in "Novitates Zoologicæ," vol. iii, Dec. 1896, pp. 428–430. Characters are subject to *independent variation* as well as *correlated variation*. Hence there may be the widest discrepancy between the transitions constructed by naturalists making use of different characters.

‡ "Life and Letters," vol. ii, p. 79.

is the dominance of the subjective element. Thus he writes about his descriptive work on Cirrhipedes to Hooker, October 12, 1849:—"I have of late been at work at mere species describing, which is much more difficult than I expected, and has much the same sort of interest as a puzzle has; but I confess I often feel wearied with the work, and cannot help sometimes asking myself what is the good of spending a week or fortnight in ascertaining that certain just perceptible differences blend together, and constitute varieties and not species. As long as I am on anatomy I never feel myself in that disgusting, horrid, *cui bono,* inquiring humour." *

On another occasion, when Darwin was anxious to ascertain the "close species" in the North American Flora, and wrote for information to Asa Gray, he frankly adopted the subjective criterion in order to explain exactly what he meant. He wrote, June 8, [1855]:—"The definition I should give of a '*close species*' was one that *you* thought specifically distinct, but which you could conceive some other *good* botanist might think only a race or variety; or, again, a species that you had trouble, though having opportunities of knowing it well, in discriminating from some other species." †

Asa Gray's reply is also very interesting from the same point of view. He wrote, June 30, 1855:—"Those thus connected" [he had bracketed the "close species" in a list of the Flora], "some of them, I should in revision unite under one, many more Dr. Hooker would unite, and for the rest it would not be extraordinary if, in any case, the discovery of intermediate forms compelled their union." ‡

Darwin was evidently in high spirits when he wrote the following passage which bears on the same subject. The "Origin" had been published on November 24, 1859, and the whole edition of 1250 copies sold on the day of issue. On November 29 he wrote to Asa Gray:—"You speak of species not having any material base to rest on, but is this any greater hardship than deciding what deserves to be called a variety, and be designated by a Greek letter? When I

* "Life and Letters," vol. i, p. 379.
† *Ibid.*, vol. ii, p. 64.
‡ "More Letters," vol. i, p. 421, Letter 324.

was at systematic work I know I longed to have no other difficulty (great enough) than deciding whether the form was distinct enough to deserve a name, and not to be haunted with undefined and unanswerable questions whether it was a true species. What a jump it is from a well-marked variety, produced by natural cause, to a species produced by the separate act of the hand of God! But I am running on foolishly. By the way, I met the other day Phillips, the palæontologist, and he asked me, 'How do you define a species?' I answered, 'I cannot.' Whereupon he said, 'At last I have found out the only true definition—any form which has ever had a specific name!'" *

The idea of a species as an inter-breeding community, as syngamic, is, I believe, the more or less acknowledged foundation of the importance given to transition. This will become clearer from the consideration of a concrete example. The common black-and-white Danaine butterfly, *Amauris niavius* of West Africa, is represented on the East and South-East Coasts by a very similar butterfly, distinguished by the greater size of the largest white patch, and of the white spot in the cell of the fore-wing. Both forms are very constant in the areas over which they were known, and on these constant easily recognisable characters the eastern butterfly was described as a distinct species under the name of *A. dominicanus.* Aurivillius, however, in his valuable Catalogue refuses to recognise this latter as a distinct species, and considers it as the *dominicanus* variety of *niavius.* Through the kindness of Mr. C. A. Wiggins and Mr. A. H. Harrison, the Hope Department has recently been presented with an exceedingly fine series of butterflies from both east and west of the northern shores of Lake Victoria Nyanza. These have been carefully studied by Mr. S. A. Neave, B.A., of Magdalen College, Oxford, who finds that the typical *niavius* occurs in great abundance to the west of the lake, while on the east he meets, in both collections, with varieties beautifully intermediate between it and *dominicanus.* These varieties, occurring precisely in the zone where the eastern form meets the western, complete for the systematist the transition which

* "More Letters," vol. i, p. 127, Letter 79.

renders *dominicanus* a variety of *niavius* and not a distinct species. But it is clear that they do more than this; they make it almost certain that the two forms freely interbreed, and constitute but a single syngamic community.

This is one of the remarkably clear examples. In many cases we know the transition, but the extremes are not sorted out in different parts of the total area of distribution. Nevertheless if complete enough the transition of forms on the same area always raises the strong presumption that we are dealing with a syngamic community.

Probably the most remarkable series of transitional varieties ever depicted is that shown in the eleven quarto plates of the last part of Monsieur Charles Oberthür's great "Études d'Entomologie," entitled "Variation des *Heliconia thelxiope* et *vesta*" (Rennes, February, 1902).

The method of diagnosis, at its clearest and simplest, is always consistent with, and often strongly suggests, an underlying syngamy. There are, however, numberless examples belonging to various categories in which a rigid adherence to diagnosis cannot avail. In these cases the systematist frankly appeals to syngamy or synepigony as decisive; and if he has not direct proof of the existence of either of these, indirect evidence is, at any rate provisionally, regarded as sufficient.

I. *Dimorphism, Polymorphism*:—In an ever-increasing number of examples an assemblage of individuals is regarded as a single species, although split up into two or more widely different and sharply separated groups, between which transitional varieties are excessively rare or even unknown. For instance, the extremely abundant, widely distributed butterfly *Limnas chrysippus* includes among other forms one in which the black-and-white tip is wanting from the fore-wing, the *dorippus* (= *klugii*) form. This variety is sharply cut off from the type form. Although faint traces of a former white bar can be made out in *dorippus*, I have never seen, among thousands of individuals, the material out of which a good transitional series between it and *chrysippus* could be constructed. In this case the evidence of syngamy is strong and complete; for Col. Yerbury has recorded the fact that the

two forms certainly occur *in copulâ*.* But if this evidence were wanting there would still be strong presumptive evidence that the forms are associated by syngamy and synepigony. Thus, so far as our knowledge extends, *dorippus* occurs as the only form in certain parts of N.E. Africa alone. From this, its metropolis, *dorippus* spreads on all sides, its individuals existing intermingled with those of *chrysippus*, becoming less and less numerous until they finally die out. Thus if we trace the two forms eastward we find them both abundant at Aden; further east, at Karachi, *dorippus* is well known, but very scarce as compared with *chrysippus*; in Southern India it is a great rarity, if indeed it is known at all on the mainland; in Ceylon a single specimen was captured by Col. Yerbury in 1891, and since then others have been taken.† Further east I have never heard of a specimen. Similarly when it is traced southward in Africa, *dorippus* is dominant in the coast strip of British East Africa, where it constitutes about three-quarters of the total number of individuals. Further to the south it becomes rarer and rarer, until in Natal and the Cape, if it occurs at all, it is even rarer than in Ceylon.‡ Such a distribution is consistent with the interpretation that *dorippus* and *chrysippus* are two forms in one syngamic community. It is difficult on any other hypothesis to account for the facts which we observe on the outskirts of

* Speaking of his experience at Aden, Col. Yerbury says: "I have taken them [the forms of *chrysippus*] *in coitu* in every possible combination." (Journ. Bomb., Nat. Hist. Soc., vii. (1892), p. 209.)

† See Major N. Manders, F.Z.S., in Journ. Bomb. Nat. Hist. Soc., xiv (1902), p. 716:—

"The first specimen of this insect [*dorippus*=*klugii*] in Ceylon was captured by Lieut.-Colonel Yerbury at Trincomalie, April 15th, 1891 . . ." Of five or six more recent examples Major Manders writes, "These specimens were captured by Mr. Pole at Puttalam on the east coast and Hambantotte on the south coast in the dryest and perhaps most arid portion of the island. It is evidently widely distributed in the desert portion of the island and is possibly not uncommon."

"The distribution of this insect in India cannot yet be fully known; it is rare in Canara, but is not yet reported from the plains of the Deccan, or Southern India, so far as I am aware, though it probably exists." The occurrence of *dorippus* at Bombay, Kutch, and Sind had been previously published by Major Manders and the late Mr. de Nicéville in Journ. As. Soc. Bengal, vol. lxviii, Pt. ii, No. 3, 1899, p. 170.

‡ Mr. Roland Trimen tells me that he knows of only three South-African *dorippus*:—two from Durban and one from Pretoria. The latter and one of the former were taken by Mr. W. L. Distant (Ann. Mag. Nat. Hist. (7), vol. i, 1898, pp. 48, 49).

the range of *dorippus*—the occasional appearance of single individuals in the swarms of the type form. And if the two are syngamic on the outskirts, the gradual transition in proportions towards the metropolis of *dorippus* suggests that they are syngamic throughout. Common as the species is—probably the commonest butterfly in the world,—the evidence from epigony has never been obtained, although from the point of view of heredity the investigation promises to be of the deepest interest.

The remarkable forms of the females of the *Papilio merope* group already alluded to afford another excellent example, although in this case good transitional series can be constructed. The evidence of syngamy was first obtained by Hewitson (see p. 19), but is now well known. The evidence of epigony has fortunately been obtained in 1902 and again within the last few weeks by one of our Fellows at Durban, Mr. G. F. Leigh. Eggs from a female of the commonest *cenea* form yielded a synepigonic group, including a large majority of forms like the parent, but also examples of the very different *hippocoon* form. Still more recently seven eggs from the rarest of the forms, *trophonius*, produced, in addition to males, two females of the *cenea* variety, and not one resembling the parent.

These differences, although only of colour and pattern, greatly exceed those between ordinary close species. When we deal with other kinds of dimorphism or polymorphism involving important structural differences, such as those of the social Hymenoptera and Neuroptera, the discriminating characters between nearly related genera are commonly equalled or exceeded.

II. *Seasonal Dimorphism* :—In certain exceedingly interesting examples of dimorphism the relation between the forms is epigonic and not syngamic ; for rare and occasional inter-breeding is not syngamy. I refer to the most strongly-marked cases of seasonal dimorphism in butterflies, especially the wonderful examples proved to be epigonic by Guy A. K. Marshall. In some of the forms the two seasonal phases were not even regarded as closely related species. In these extraordinary cases, where the widest difference in colour and pattern exists, in combination with others which are far more deep-seated,

I urged upon Mr. Marshall that the few recorded examples of capture or observation *in coitu* were insufficient evidence of specific identity, and that nothing short of epigony would suffice.

In seasonal dimorphism, in the dimorphism of social insects, and doubtless in a large proportion of other examples, it is probable, indeed often certain, that the different forms are produced in response to some stimulus which acts at a specially susceptible period of the life-history; but from the point of view of the systematist the mature individuals can only be known as forms which, structurally widely different, must nevertheless be placed within the limits of a single species. The investigation of the probable physiological causes of difference is, however, of the utmost importance from other points of view. Altogether apart from its bearing upon dimorphism, the effect of individual susceptibility to stimulus requires treatment in a separate category.

III. *Individual Modification:* *—One of the most striking developments of recent years has been the growth in the number of these very cases in which an individual animal or plant has been rendered by natural selection susceptible to some stimulus associated with each one of its possible normal environments. Every individual of such species comes into the world with two or more very distinct and very different possibilities before it, each of which will be realised only in the appropriate environment—realised as the response to some stimulus provided by the environment itself. We can see clearly that this idea was in Darwin's mind, although there were then but few facts which pointed in its direction. Thus in Schmankewitsch's experiments Crustacea of the species *Artemia salina* were described as gradually changing in the course of generations, as the result of a progressive freshening of the water in which they were kept, until they took on the characters of the genus *Branchipus.* On this subject Darwin wrote to Karl Semper, February 6, 1881:—"When I read imperfectly some years

* "A structural change wrought during the individual's lifetime (or acquired), in contradistinction from variation, which is of germinal origin (or congenital)." Dict. of Phil. and Psych., ed. by J. Mark Baldwin, New York and London, vol. ii, 1902, p. 94.

ago the original paper, I could not avoid thinking that some special explanation would hereafter be found for so curious a case. I speculated whether a species very liable to repeated and great changes of conditions might not assume a fluctuating condition ready to be adapted to either conditions." *

I venture to express the prediction that this class of cases, already very numerous, will hereafter be immensely enlarged, and will become especially important in the vegetable kingdom.† Although Hooker at one time took the opposite side, and thought that plants were never "changed materially by external conditions—except in such a coarse way as stunting or enlarging," ‡ Darwin considered that "physical conditions have a more direct effect on plants than on animals." § Undoubtedly the view at the time was that of Buffon, the idea of an operation of the environing forces almost as direct as those which produce the weathering of rocks or the whitening of an exposed flint. But it is probable that the more intimately we know of the conditions of plant-life, the more fully it will be recognised that all such changes are adaptive.

* "More Letters," vol. i, p. 391, Letter 303.

† See "Stimulus and Mechanism as Factors in Organisation" by J. Bretland Farmer, F.R.S. (the New Phytologist, vol. ii, Nos. 9 and 10 Nov. and Dec. 1903). Professor Farmer speaks of the probable prevalance in the plant-world of "a constant specific mechanism that is able to be actuated in different ways by different kinds of stimuli." Although for the purpose of his paper Professor Farmer is concerned with the train of physico-chemical sequences which is set going, utility or no utility, whenever the mechanism of an individual is stimulated, he fully admits that the mechanism itself has come to be a character of the species by the operation of natural selection. "Naturally," he says, "only those species whose inner character expressed itself in making these 'suitable' adjustments to the environment were able to survive."

Toward the close of his paper Professor Farmer seems to bring the considerations that have regard to the species into somewhat unnecessary conflict with those that have regard to the individual. Thus he says that "current literature still teems with teleological explanations that really explain nothing, but rather bar the way of scientific enquiry."

A properly loaded, well-constructed modern gun goes off, for disadvantage no less than for advantage, when its trigger is pulled; but the very existence of the gun depends upon a long succession of past stages, each of which was more advantageous than its predecessor. The recognition of this history does not bar the way of enquiry, but rather stimulates and suggests a searching and intelligent study of the latest mechanism with all its intricacy.

‡ See the letter from Hooker to Darwin, March 17, 1862, in "More Letters," vol. i, p. 197.

§ See the letter from Darwin to Lyell [June 14, 1860], "Life and Letters," vol. ii, p. 319.

I will mention merely by way of illustration, that my attention has been called in recent years to the dwarfing effect of the prevalent south-western winds on the vegetation of the exposed chalk downs of the Isle of Wight. It has occurred to me as a mere suggestion, but one worth investigating, that the effect of wind upon a tall flower-head might be such as to render less easy and less frequent the visits of insects. If this were so, it would perhaps explain why certain species of entomophilous plants liable to grow in such situations have gained a special susceptibility to the stimulus provided by constant winds during some particular period of growth. The absence of this stimulus would also correspond to a condition in which the plants would gain in the conspicuousness brought about by increased height.

The further growth of a class already proved to be large, would play havoc with a definition of species rigidly based upon discriminating structural characters alone.

IV. *Geographical Races or Sub-Species*:—If we depend upon unaided diagnosis there is no means of discriminating between species and those sub-species of which the whole mass of individuals are distinguished by recognisable characters. Here again the mere beginning of the difficulty is in sight; for as museums recognise more and more the necessity for long series of specimens with exact geographical data, so will the comparatively simple conception of the single species be replaced again and again by the far more complex but much truer idea of sub-specific groups still fused by syngamy into a single species, but as it were trembling on the edge of disruption, ever ready, by the development of pronounced preferential mating or by the accumulated incidental effects of isolation prolonged beyond a certain point, to break up into distinct and separate species.

V. *Results of Artificial Selection*:—These obvious difficulties encountered by a mechanical adherence to definition by diagnosis naturally lead to the consideration of the further difficulties presented by domestic races of animals and plants. The wide structural differences between the forms accumulated by human selection greatly impressed Darwin. Thus he wrote to Hooker, September 8, [1856]:—"By the way, I have been astonished at the

differences in the skeletons of domestic rabbits. I showed some of the points to Waterhouse, and asked him whether he could pretend that they were not as great as between species, and he answered, 'They are a great deal more.' How very odd that no zoologist should ever have thought it worth while to look to the real structure of varieties. . . ." * Then again, the differences between many of our domestic breeds, and between them and the nearest wild species, are, as is well known, generic rather than specific. Why do we not consider such races to be of different species and genera? Because of the criterion suggested by Lankester; because we have reason to believe in their descent from common parents within the historic period; because, in spite of their wide differences, they are still syngamic.

What is the practical bearing of these criticisms upon the definition of species by diagnosis and diagnosis alone? The systematist, confronted by his series of specimens in a museum cannot do otherwise than arrange them in groups which he will describe and name as species. But much would be gained if he admitted at the outset that his conclusions are provisional, if he said with Dr. Karl Jordan, "The actual proof of specific distinctness the systematist as such cannot bring; . . . we work, or we ought to work, with the mental reservation that the specific distinctness of our *species novæ* deduced from morphological differences will be corroborated by biology." †

The advantage of this attitude is obvious. Work would go on as at present. Powers of acute observation and good judgment would still furnish descriptions of species to be hereafter confirmed or confirmed at the time by observation and experiment upon the living material. But the systematist would not only receive our gratitude for the performance of these important and necessary duties: he would also be seeking in every direction for the evidence of syngamy and of epigony. The museum would become a centre for the inspiration of researches of the highest interest to the investigator himself, of the greatest importance to the whole body of naturalists.

* "More Letters," vol. ii, p. 210, Letter 543.

† "Novitates Zoologicæ," vol. iii, Dec. 1896, pp. 450, 451. I here desire to express my indebtedness to the author of this learned and valuable paper.

We now turn to the consideration of interspecific sterility, which many have supposed to be an infallible criterion. Huxley himself felt this so strongly that he was, in consequence, never able to give his full assent to natural selection. The grounds of his objection were the subject of prolonged correspondence with Darwin. In order to prove that natural selection has produced natural species separated rigidly, as he believed, by the barrier of sterility, Huxley maintained that we ought to be able to produce the same sterility between our artificially selected breeds; and until this had been done he could not thoroughly accept the theory of natural selection. This objection he expressed, or implied, in many speeches and writings up to within a few months of his death. One of the simplest statements is contained in a letter to the late Charles Kingsley. Huxley wrote, April 30, 1863, "Their produce [viz. that of Horse and Ass] is usually a sterile hybrid.

"So if Carrier and Tumbler, *e. g.*, were physiological species equivalent to Horse and Ass, their progeny ought to be sterile or semi-sterile. So far as experience has gone, on the contrary, it is perfectly fertile—as fertile as the progeny of Carrier and Carrier or Tumbler and Tumbler.

"From the first time that I wrote about Darwin's book in the *Times*, and in the *Westminster*, until now, it has been obvious to me that this is the weak point of Darwin's doctrine. He *has* shown that selective breeding is a *vera causa* for morphological species; he has not yet shown it a *vera causa* for physiological species.

"But I entertain little doubt that a carefully devised system of experimentation would produce physiological species by selection—only the feat has not been performed yet."*

It was against this same view, as expressed in Huxley's "Lectures to Working Men" in 1863, that Darwin argued with convincing force in many letters. The main facts with which he confronted Huxley again and again were the artificially selected races of certain plants which are sterile *inter se.* The position is clearly expressed in the following amusing, vehement passages from two letters:—

* "Life and Letters of Thomas Henry Huxley," vol. i, p. 239.

"*Dec.* 18, [1862.]

"Do you mean to say that Gärtner lied, after experiments by the hundred (and he a hostile witness), when he showed that this was the case with *Verbascum* and with maize (and here you have selected races): does Kolreuter lie when he speaks about the varieties of tobacco? My God, is not the case difficult enough, without its being, as I must think, falsely made more difficult? I believe it is my own fault—my d——d candour: I ought to have made ten times more fuss about these most careful experiments." *

"[*Jan.*] 10, [1863.]

"In plants the test of first cross seems as fair as test of sterility of hybrids, and this latter test applies, I will maintain to the death, to the crossing of varieties of *Verbascum*, and varieties, selected varieties, of *Zea*. You will say, Go to the Devil and hold your tongue. No, I will not hold my tongue; for I must add that after going, for my present book [Variation under Domestication], all through domestic animals, I have come to the conclusion that there are almost certainly several cases of two or three or more species blended together and now perfectly fertile together. Hence I conclude that there must be something in domestication,—perhaps the less stable conditions, the very cause which induces so much variability,—which eliminates the natural sterility of species when crossed. If so, we can see how unlikely that sterility should arise between domestic races. Now I will hold my tongue." †

Darwin made attempts to "produce physiological species by selection," and thus meet his friend's criticism. He thought out and suggested a plan of experiment to W. B. Tegetmeier,‡ and gave a brief account of the scheme to Huxley, December 28, [1862]:—"I have —— given him [Tegetmeier] the result of my crosses of the birds which he proposes to try, and have told him how alone I think the experiment could be tried with the faintest hope of success—namely, to get, if possible, a case of two birds which when

* "More Letters," vol. i, p. 230, Letter 156.
† *Ibid.* vol. i, pp. 231, 232, Letter 157.
‡ *Ibid.* vol. i, pp. 223, 224, Letter 153, [1862, Dec.] 27.

paired were unproductive, yet neither impotent. For instance, I had this morning a letter with a case of a Hereford heifer, which seemed to be, after repeated trials, sterile with one particular and far from impotent bull, but not with another bull. But it is too long a story—it is to attempt to make two strains, both fertile, and yet sterile when one of one strain is crossed with one of the other strain. But the difficulty . . . would be beyond calculation." *

The experiment was evidently unsuccessful,—perhaps was never seriously undertaken,—and a few years later Darwin added the following postscript to a letter to Huxley, January 7 [1867].

"P.S.—Nature never made species mutually sterile by selection, nor will men." †

This was probably only an offhand expression of opinion, not intended to be taken seriously. An altogether hopeless attitude would not be reasonable until the suggested scheme had been applied many times, and in several parts of the animal and vegetable kingdoms.

But the positive results demanded by Huxley, even if obtained, would by no means justify his far-reaching conclusions. If the barrier of sterility were thus artificially produced, we should be very far from the proof that its existence in nature is due to the same kind of cause, viz. selection. If Darwin was right in his controversy with Wallace, if "Nature never made species mutually sterile by selection," the suggested experiment would merely do by artificial selection what is not done by natural selection.

It is by no means difficult to understand the mutual sterility which is usual between natural species as an incidental result of their separation by asyngamy for a long period of time. In the process of fertilisation a portion of a single cell nucleus from one individual fuses with a portion from another individual, the two combining to form the complete nucleus of the first cell of the offspring, from which all the countless cells of the future individual will arise by division. Each part-nucleus contains the whole of the hereditary qualities

* "More Letters," vol. i, pp. 225, 226, Letter 154.
† *Ibid.* vol. i, p. 277, Letter 197.

received from and through its respective parent, and must therefore be of inconceivable complexity. We can only speak in generalities about processes of which so little is known, but we cannot be wrong in assuming that sterility is sometimes due to the fact that the complex architecture of one part-nucleus fails in some way to suit the equally complex structure of the other. The individuals of an inter-breeding community form a biological whole, in which selection inevitably keeps up a high standard of mutual compatibility between the sexual nuclei. Individuals whose sexual nuclei possess a structure which leads to sterile combinations with those of other individuals are excluded from contributing to the generations of the future. As soon, however, as a group of individuals ceases, from any reason, to breed with the rest of the species, there is no reason why the compatibility of the sexual nuclei of the two sets should be retained. Within each set, selection would work as before and keep up a high standard of compatibility; between the sets, compatibility would only persist as a heritage of past selection, gradually diminishing as slight changes of structure in either or both of the sets rendered them less and less fitted to produce fertile combinations.*

It is probable that of all the nice adjustments required in the living organism, the mutual adjustment of these inconceivably complex part-nuclei is the most delicate and precise. Now, delicately adjusted organs, such as those of sight, rapidly become incapable of performing their functions when in any species they have been withdrawn from the operation of natural selection; similarly it is suggested, that the adjustment of sexual nuclei to each other would sooner or later give way

* I must guard against the inference that the only explanation of sterility is here set forth. It is indeed maintained that incompatibility of the sexual part-nuclei is the inevitable outcome of enduring asyngamy, and is the almost certain cause of the sterility of hybrids. And it may be suggested that sterility is a result of the combination of two incompatible germ-plasms in the sexual cells of the hybrid. When the incompatibility is not strongly marked we can understand how such sexual cells may be capable of fertile fusion with the cells of either parent, but not with those of another hybrid.

But short of these ultimate effects it must not be forgotten that there are many obscure factors of asyngamy—causes of various kinds which interfere with the fusion under normal conditions or entirely prevent the meeting of the sexual cells.

when no longer sustained by selection. If, then, mutual fertility be the result of unceasing selection, and mutual sterility the inevitable, even if long-postponed, consequence of its cessation, it is obvious that Huxley's difficulty is solved, while his suggested experimental creation of sterility by selection would not reproduce any natural operation: it would afford a picture of a natural result but would be produced in an unnatural way. This criticism of Huxley's contention was advanced by the present writer three years ago,* the final conclusion being stated in the paragraph printed below:—

"If, then, we cannot as yet reproduce by artificial selection all the characteristics of natural species-formation, but can only imitate natural race-formation, we can nevertheless appreciate the reasons for this want of success, and are no more compelled to relinquish our full confidence in natural selection than we are compelled to adopt a guarded attitude towards evolution because our historical records are not long enough to register the change of one species into another."†

It was therefore with intense interest and pleasure that I read the following sentences in a letter written by Darwin to Huxley, Dec. 28, [1862]—sentences which show that criticism practically identical had been made by the illustrious naturalist nearly forty years earlier.

"We differ so much that it is no use arguing. To get the degree of sterility you expect in recently formed varieties seems to me simply hopeless. It seems to me almost like those naturalists who declare they will never believe that one species turns into another till they see every stage in progress." ‡

After reading, in the first volume of "More Letters," the often-repeated refutation of Huxley's objection so clearly and strongly expressed in letters received by the objector himself, it is surprising that no effect was produced, and that reference should have been nearly always made to this supposed flaw in the theory of natural selection, whenever the great compara-

* "The Quarterly Review," No. 385, January 1901, pp. 368–371.

† *l. c.* p. 371.

‡ "More Letters," vol. i, p. 225, Letter 154.

tive anatomist had occasion to speak or write on the broader aspects of biological inquiry.*

Darwin also considered that there was something in the very conditions of domestication which tended to promote fertility between races and even between distinct species. Thus he followed Pallas in believing that the domestic dog has been derived from more than one wild species, although he did not trace existing differences to this cause but to artificial selection.† However, as regards the origin of the dog, "the evidence is, and must be, very doubtful," as he wrote to Lyell, August 11, [1860]. The fact which Darwin "considered the most remarkable as yet recorded with respect to the fertility of hybrids," was the fertility of the offspring of the Common and Chinese Goose, originally described by Eyton, and confirmed by Goodacre and by Darwin himself. "The two species of goose now shown to be fertile *inter se* are so distinct that they have been placed by some authorities in distinct genera or sub-genera." ‡

Another interesting and exceedingly difficult experiment in hybridisation has been carried through by the Rev. P. St. M. Podmore, F.Z.S., who in Sept. 1899, after numerous failures, succeeded in rearing a healthy male hybrid between the Ring Dove (*Columba palumbus*) and the domestic pigeon. On May 27, 1903, this male was mated with a Blue Homer hen, which produced healthy offspring. §

* For several instances see Poulton's "Charles Darwin and the Theory of Natural Selection," Lond. 1896, pp. 124–141.

† "Though I believe that our domestic dogs have descended from several wild forms, and though I must think that the sterility, which they would probably have evinced, if crossed before being domesticated, has been eliminated, yet I go but a very little way with Pallas & Co. in their belief in the importance of the crossing and blending of the aboriginal stocks.

* * * * * * *

"Although the hound, greyhound, and bull-dog may possibly have descended from three distinct stocks, I am convinced that their present great amount of difference is mainly due to the same causes [artificial selection] which have made the breeds of pigeons so different from each other, though these breeds of pigeons have all descended from one wild stock; so that the Pallasian doctrine I look at as but of quite secondary importance."

"More Letters," vol. i, pp. 127, 128, Letter 80, to Lyell, Oct. 31, [1859].

‡ "Life and Letters," vol. iii, p. 240.

§ "The Zoologist," Nov. 1903, p. 401.

A comparison between the difficulty of producing such a cross and that of obtaining hybrids between the Ring Dove and the Rock Pigeon, the ancestor of the domestic breeds, would probably throw much light on the Pallasian hypothesis.

If the view here proposed be sound—that syngamy lies behind, and is at least provisionally implied in the transition which means so much to the systematist, and is his only real evidence when the structural test breaks down, the conclusion is suggested that the real interspecific barrier is not sterility but asyngamy. Nevertheless, as argued on pages 36–8, asyngamy will infallibly lead to sterility, although the result may be long delayed. This latter view, which was that of Darwin, is the exact opposite of the "physiological selection" of Romanes, in which sterility is supposed to arise spontaneously, asyngamy being not the cause, but the consequence.

Asyngamy may be brought about in various ways, of which the most obvious is geographical separation. But asyngamy is by no means the necessary result of geographical discontinuity or asympatry. Thus Darwin considered that there is regular inter-breeding between Madeiran and continental birds of the same species. He wrote to Hooker, August 8 [1860]. "I do not think it a mystery that birds have not been modified in Madeira. Pray look at p. 422 of *Origin* [ed. iii]. You would not think it a mystery if you had seen the long lists which I have (somewhere) of the birds annually blown, even in flocks, to Madeira. The crossed stock would be the more vigorous." * An even more striking case is that of *Pyrameis cardui*, which ranges over nearly the whole world. The singular absence of local geographical races in this abundant butterfly is almost certainly due to the astonishing powers of dispersal which enable intermittent syngamy to prevail over the whole vast area of its distribution.

An interesting and curious cause of persistent asyngamy is the "Mechanical Selection" so thoroughly explained and abundantly illustrated by Karl Jordan.† The complex genital armature of Lepidoptera is during syngamy kept constant by

* "More Letters," vol. i, pp. 487, 488, Letter 370.
† *l. c.* p. 518–522.

unceasing selection. Comparatively brief isolation of a group of individuals may lead to a departure from the specific type of apparatus prevalent in other areas, and may thus mechanically prevent syngamy if from any cause members of the group became again sympatric with those of the parent species.

A very different but exceedingly interesting origin of asyngamy is suggested by observations which support the conclusion that varietal forms may show a tendency towards preferential inter-breeding.

H. W. Bates believed that he had strong evidence for the existence of this tendency in the races of certain tropical American butterflies. He stated this in his epoch-making paper on the butterflies of the Amazon valley,* and it is interesting to observe in the published letters how Darwin instantly fixed upon the point and tried to elicit the data upon which the conclusion was formed. Thus he wrote to Bates, Nov. 20 [1862]:—"No doubt with most people this [viz. the interpretation of Mimicry] will be the cream of the paper; but I am not sure that all your facts and reasonings on variation, and on the segregation of complete and semi-complete species, is not really more, or at least as valuable, a part. I never conceived the process nearly so clearly before; one feels present at the creation of new forms. I wish, however, you had enlarged a little more on the pairing of similar varieties; a rather more numerous body of facts seems here wanted." †

Then a few days later we find Darwin still thinking of the subject, and writing to Hooker [1862, Nov.] 24:—"I have now finished his [Bates'] paper . . .; it seems to me admirable. To my mind the act of segregation of varieties into species was never so plainly brought forward, and there are heaps of capital miscellaneous observations." ‡

He also again wrote to Bates, probably on the following day, Nov. 25 [1862?], asking for the solid facts which are so greatly wanted:—

"Could you find me some place, even a footnote (though

* Trans. Linn. Soc., vol. xxiii (1862), p. 495.
† "Life and Letters," vol. ii, p. 392.
‡ "More Letters," vol. i, p. 214, Letter 147.

these are in nine cases out of ten objectionable), where you could state, as fully as your materials permit, all the facts about similar varieties pairing—at a guess how many you caught, and how many now in your collection? I look at this fact as very important; if not in your book, put it somewhere else, or let me have cases." *

Remembering that Mr. Roland Trimen, F.R.S., had expressed the same opinion as the result of his wide and long experience of South African butterflies, I asked him if he would kindly furnish me with a statement. His reply, dated Dec. 28, 1903, is as follows:—

"*Dec.* 28, 1903.

"I have noticed the tendency of the sexes of a variety to pair together rather than with other varieties in the numerous cases of captured pairs sent to me by correspondents in South Africa, and sometimes in cases of the same kind which occurred to myself when collecting. The species which particularly attracted my notice in this way during my visit to Natal was *Hypanis acheloia* (= *Götzius*, Herbst, part), which is curiously variable on the underside, from pale creamy to deep chocolate. I did not know of its *seasonal* variation at the time, but I was in Natal just at the change of season from wet to dry, when the intermediate gradations were about, and I was struck with the close resemblance of the sexes in pairs that I caught. I am sorry to have nothing more definite to give on this head; it is a point much requiring exact and prolonged observation."

Mr. Trimen furthermore entertains no doubt that much, if not all, of the material upon which he based the conclusion that the individuals of the same race tend to interbreed, exists, distinctively labelled, in the South African Museum, at Cape Town. It is greatly to be hoped that collectors will in future carefully label all specimens captured *in coitu*, and that the fact will be recorded on the labels in museums and in private collections. It is tantalising to reflect upon the number of interesting and important questions which could be now decided if this practice had prevailed during the past fifty years. The question of the possible origin of species

* "More Letters," vol. i, p. 215, Letter 148.

from races by preferential syngamy is of such high importance that we may confidently hope that the attention here directed to the question, and especially the quotation of Darwin's letters to Bates, may lead to that "exact and prolonged observation," accompanied by careful records, without which a safe decision cannot be reached. In the meantime the decided impressions of two such naturalists as H. W. Bates in South America and Roland Trimen in South Africa render it in every way probable that the conclusion will be established on a firm foundation.*

It is also possible that asyngamy may be brought about by the breaking of what we may call "a syngamic chain." In the case of large and widely-distributed interbreeding communities, it is an open question whether syngamy would freely take place between the most distant of the outlying sections if directly brought into contact, and whether, even if syngamy prevailed, there would be any diminution in fertility.

Limnas chrysippus, perhaps the commonest butterfly in the world, forms a probably continuous syngamic chain stretching from the Cape of Good Hope at least as far as Southern China. It is even reported from Japan. The far Eastern forms are readily distinguishable by the greater size of a single white spot, giving quite a different appearance to the fore-wing. If pupæ or eggs were transferred from Hong-Kong or Macao to South Africa, would the perfect butterflies freely interbreed

* Dr. T. A. Chapman sends me the following interesting and suggestive note:—

"I met lately with a curious instance that deserves following up, of some bearing on the question of selective mating of varieties.

"I saw some broods of *P. phlæas* lately that differed from each other, but each brood was remarkably uniform. There were three broods, all bred in the same conditions, in a greenhouse (by Mr. Carpenter of Leatherhead). It seems difficult to explain this, unless *both* parents of each brood were very nearly identical.

"Mr. Frohawk, who has bred the species largely, tells me he has noticed similar facts.

"When I bred *Acronycta tridens* and *psi* largely, some fifteen or more years ago, I noticed that each brood had its own pairs, and suggested that *tridens* was now trying to break up into separate species just as some ancestor split into *psi*, *tridens* and *cuspis*.

"Another fact I observed in *Acronycta* rather bears on the other side of the question. Of *A. strigosa* I reared a large brood, which paired readily and frequently together, but no eggs were laid. I then got some captured males, which paired with equal readiness with the bred females, and as a result obtained plenty of fertile eggs."

with the indigenous forms of *chrysippus?* We do not know; but it is an experiment well worth trying, and one which would yield results valuable in many ways. If inter-breeding did not take place, or if the unions were sterile, then we should have the interesting case of a single species which would instantly become two if through any circumstance a central link dropped out of the chain. Even if *chrysippus* yielded negative evidence in this respect, it is highly probable that other widely-distributed species would, under these circumstances, fall into two or more groups, each held together by inter-breeding, and divided from others by asyngamy.

Sterility, if present in any degree, would have been brought about quite independently of selection; for in such cases each link of the chain would be freely syngamic with the links on either side, and asyngamy or sterility would only be revealed by artificially bringing together the widely-separated ends of the chain.

I cannot but think, therefore, that such experiments made upon many carefully-selected species would probably bring important additional evidence to bear upon the controversy as to whether sterility between species is, as Wallace believes, a selected quality, or, as Darwin held, an incidental one. The deep interest of this question is realised when we thus remember that the two discoverers of natural selection held widely different opinions about it. We cannot read the letters on both sides, printed in the first volume of "More Letters," without realising how deeply this divergence—one of the principal differences between them—was felt by the two great naturalists.

This is one of the many reasons for which I plead with Mr. Roland Trimen for the establishment of tropical biological stations where work of the kind could be carried on. Such establishments should be associated with and be under the control of museums at home, where the experiments could be directed and the results studied and made available for all time for the researches of the naturalist. Just as Harvard has her main Observatory at the University, but also maintains an outlying institution in the Peruvian Andes, where certain kinds of research, unsuited to New England,

can be carried on under the most favourable conditions, so our chief museums should be provided with the means of establishing temporary stations in the most favourable parts of the tropics. When I say temporary, I do not refer to the means, but to the position of the station, which should be freely movable in response to the call of important problems as they present themselves for solution in other localities.

Another urgent reason for the establishment of biological stations is forced upon us by the inadequacy of diagnosis for the separation of very variable species, such as many of the African *Acræinæ*. I cordially agree with the view often expressed to me by my friend Mr. F. A. Heron, that we shall never reach a secure foundation until synepigonic series have been obtained on a large scale. To achieve this end a temporary station would be required. In this way our museums could receive, and should keep for permanent study, the *whole* of the offspring reared from the eggs of a single parent. If several species were thus represented by one or more large synepigonic series, we should know what to expect and what to allow for; and diagnosis in general would gain the most helpful guidance.

Asyngamy, as regards particular lines of union, has also been incidentally brought about by certain adaptations for cross-fertilisation in plants, and such asyngamy has in some cases persisted long enough to have led to sterility in greater or less degree. Of all Darwin's work, that upon the fertilisation of heterostyled plants threw most light, he considered, upon sterility between species. As Francis Darwin has stated, "He found that a wonderfully close parallelism exists between hybridisation and certain forms of fertilisation among heterostyled plants. So that it is hardly an exaggeration to say that the 'illegitimately' reared seedlings are hybrids, although both their parents belong to identically the same species. In a letter to Professor Huxley, given in the second volume [of 'Life and Letters'], p. 384, my father writes as if his researches on heterostyled plants tended to make him believe that sterility is a selected or acquired quality. But in his later publications, *e. g.* in the sixth edition of the 'Origin,' he adheres to the belief that sterility

is an incidental rather than a selected quality. The result of his work on heterostyled plants is of importance as showing that sterility is no test of specific distinctness, and that it depends on differentiation of the sexual elements which is independent of any racial difference." *

The different forms of a heterostyled plant are adapted for cross-fertilisation by insects, and each individual of each form is by the same means excluded more or less completely from fertilisation by another of the same form. In the former case the sexual cells and the accessory apparatus have been kept by selection during long generations of syngamy in a high state of mutual compatibility; in the latter asyngamy, partial or complete, has produced a large measure of the sterility which is its inevitable even if long-delayed result.

This argument has, I admit, carried me much further than I originally intended, and it will be a pleasure to me if the following criticism can be overthrown.

If the special adaptation of heterostyled plants for particular lines of syngamy has incidentally resulted in lessened fertility, when the unions discouraged by these adaptations are artificially secured, and in this case without appeal to the physiologically injurious effects of self-fertilisation, why should we not similarly explain these effects whenever manifest in the self-bred † offspring of any plant especially adapted for cross-fertilisation?

Darwin tells us in the Autobiography that as soon as his "attention was thoroughly aroused to the remarkable fact that seedlings of self-fertilised parentage are inferior, even in the first generation, in height and vigour to seedlings of cross-fertilised parentage," ‡ he entered upon a series of experiments which lasted eleven years, appearing in 1876 as "Effects of Cross and Self-Fertilisation in the Vegetable Kingdom." Of this work he wrote in 1881, "the results there arrived at explain, as I believe, the endless and wonderful contrivances for the transportal of pollen from one plant to another of the same species." § It is here suggested that

* "Life and Letters," vol. iii, p. 296.

† See Francis Darwin on "The Knight Darwin Law," Nature, October 27, 1898, p. 630.

‡ "Life and Letters," vol. i, p. 96. § *Ibid.*, vol. i, p. 97.

these injurious results have been not the cause but the con sequence of specialisation for cross-fertilisation. In such plants fertil sation is mainly brought about along the line for which special adaptation is made: self-fertilisation is relatively infrequent, often very rare, sometimes perhaps absent altogether. May not the less successful results have followed from a condition in which self-fertilisation is but little tried by the fires of selection?* It would be of much interest to compare a long series of experiments on the cross-fertilisation of plants which are habitually self-fertilised and on the self-fertilisation of plants in which the adaptations for cross-fertilisation are made use of in widely different degrees.

This criticism, should it be sustained, would of course throw much light upon the case of the Bee Orchis and the numbers of tropical Orchidaceæ, etc., which are now known to be regularly self-fertilising without apparent physiological injury. It might also have a bearing upon an intrusive set of facts which must often have weighed upon the minds of naturalists as they reflected upon the commonly received hypothesis that assumes the dangers of continued breeding between near of kin. A. R. Wallace speaks of these facts in "Darwinism,"† and I have drawn attention to them in discussing the meaning of insect migration, although, as will be seen in the following passage, without any serious doubt as to the physiological significance of cross-fertilisation.‡

"We may well inquire why it should be necessary for such emigration, with a possible successful issue in colonisation, to require the services of countless individuals when the importation of half-a-dozen rabbits or a few specimens of *Pieris rapæ* will, for the naturalist, change the face of a continent. The results of these unintentional, or intentional but ill-considered, experiments do indeed shake the belief in the paramount necessity for crosses and the dangers of in-and-in breeding; but the end is not yet, and the teeming colonies which have arisen from such small beginnings may in time vanish from the operation of deep-seated causes. The varied adaptations for cross-fertilisation and the prevention of in-and-in breeding

* See also A. R. Wallace in "Darwinism," London, 1889, pp. 321–326.

† p. 326. ‡ Trans. Ent. Soc. Lond., 1902, pp. 460–465.

are so evident in nature, that we are compelled to believe that they meet and counteract serious dangers which sooner or later would menace the very existence of the species. And among other adaptations it is significant that the instinct under discussion should lead to the streaming of large populations, and not of small batches of individuals, from an area of high-pressure." *

It is impossible to consider the advantages which may have favoured cross-fertilisation, if hereafter the generally accepted physiological necessity turn out to be a delusion. Brief reference may, however, be made to the special advantages of community which are possible through syngamy alone. By inter-breeding the favourable variations arising in one direction are combined with others arising in different directions; by the kaleidoscopic changes produced by inter-breeding more varied results are presented for selection, and the beneficial qualities arising in one part of the mass may quickly become the heritage of the whole; by inter-breeding excessive spontaneous variation is checked, and the whole community of the species advances surely and with stability into adjustment with the progressive changes of the environment.

We all remember Darwin's beautifully elaborated metaphor † by which the past history of evolution is shown forth in the form and branching of a great tree. Darwin represented species by the "green and budding twigs," and we may suppose that the leaves stand for individuals, and that syngamy is represented by the contact of leaf with leaf when the branches sway in the wind. And just as contact may run through large and small, irregular and compact masses of leaves, so syngamy binds together groups of varying size and distribution. So too a mass of foliage breached by a sudden storm pictures for us the splitting of a syngamic chain into two species by the disappearance ~~of~~ an intermediate link.

It has been a pleasure to me that the central idea which I have endeavoured to bring before you should be represented, I trust without violence to the imagery, by means of "the great Tree of Life, which fills with its dead and broken branches the crust of the earth, and covers the surface with its ever-branching and beautiful ramifications." ‡

* *l. c.* p. 464. † "Origin of Species," 1859, p. 129. ‡ *l. c.* p. 130.

4

AN ADDRESS

ENTITLED

THE BEARING OF THE STUDY OF INSECTS UPON THE QUESTION

"ARE ACQUIRED CHARACTERS HEREDITARY?"

READ BEFORE THE

ENTOMOLOGICAL SOCIETY OF LONDON

AT THE

ANNUAL MEETING

ON THE

18TH JANUARY, 1905.

BY

PROF. EDWARD B. POULTON, D.Sc., M.A.,
HON. LL.D. PRINCETON, F.R.S.,
HOPE PROFESSOR OF ZOOLOGY IN THE UNIVERSITY OF OXFORD,
FELLOW OF JESUS COLLEGE, OXFORD,

President of the Society.

THE PRESIDENT'S ADDRESS.

Gentlemen,

It is a great pleasure to be able to congratulate the Society on another year of prosperity. I need add no words on this subject to the Report of the Council.

The thoughts of prosperity and stability are inevitably associated with the memory of one who worked long and hard to secure these advantages for us, of one whose death in the midst of his official work will always invest the past year with peculiar pathos. All that has been gained by the devotion of our late Treasurer will, we know full well, be preserved for us by the care and skill of his successor, who most kindly consented to come forward and help us, almost without notice. I am sure that you will wish to express special gratitude to Mr. Albert H. Jones for his services to the Society under circumstances of great difficulty and sorrow.

The loss of so important an officer as the Senior Secretary is a serious event in the history of any Society, and in the retirement of Mr. Herbert Goss we are losing one who has served as an officer for the record-breaking period of fifteen years. He first entered the Council in January 1885, and was almost at once induced to accept the Secretaryship, holding the position from 1885 to 1897. The Society, however, could not assent to his permanent withdrawal, and in January 1901 he was again elected to the office which he held until his retirement on the present occasion. We shall greatly miss his genial presence from the official chair, as well as the advancement of the interests of the Society which his position enabled him to promote so successfully. Our warmest wishes go with him: we know that the feelings which prompted him to do so much for our community in office will still remain the same out of office, and that the Society has no more loyal member or truer

friend. We are fortunate in securing as his successor one who has already acted as Secretary, and knows full well the difficulties and responsibilities as well as the keen interest and the honour that belong to the position. To his many other qualifications Commander Walker adds this supreme qualification. The Society has never had an officer with a wider experience of Entomology, or one who, from his capacious and varied store—material and mental—has more freely extended help and sympathy to his brother Fellows.

Amid these changes we remember with especial gratification that the tried and trusted services of our Librarian, Mr. G. C. Champion, and of Mr. H. Rowland-Brown, who now becomes Senior Secretary, are still to be employed for the benefit of the Society.

ROBERT MCLACHLAN, F.R.S.—No more pathetic event has happened, in our history of well nigh three-quarters of a century, than the death of a chief officer, in the midst of the work which he loved,—work which, in spite of the weakness and anxiety induced by ill-health, always commanded his devotion and energy.

So full of zeal was our late Treasurer for the welfare of the Society, that there is reason to fear that the inability to perform the important duties of his responsible post was a bitter disappointment added to the inevitable troubles of illness. It is some satisfaction to know that the Council took every possible step to allay that anxiety, and to feel that their action was attended by some measure of success.

In the "Chapter of an Autobiography," which forms the concluding part of McLachlan's second presidential address to this Society * we gain very clear knowledge of the early age at which he showed himself pre-eminently fitted to be a student of Nature. This is probably always true of those who are to achieve high distinction in this great school of learning. We may give opportunity generously, and be the richer for the free growth of genius under the most favourable conditions: we may refuse opportunity and receive as our due deserts a power which makes for good cramped and stunted. But under any circumstances the power itself is from within.

* Proc. Ent. Soc. Lond. 1886, p. lxxxi.

A great naturalist no less than a poet "is born, not made." Science is fortunate in the circumstances which surrounded the youth of Robert McLachlan :—childhood up to the age of fifteen spent on the borders of Hainault Forest, with all the varied interests botanical and zoological which such surroundings would awake in those with eyes to see them,—removal to London with its stores of literature within easy reach and kind friends to aid the young student in the search—the experience, so inspiring to the naturalist, of a long voyage, with two months' hard work plant-collecting in Australia—an introduction on the return home to the great Robert Brown who gave first kind help, then sound advice. Then after this broad foundation in natural history as a whole, the stimulus towards special work received at the psychological moment from the writings of Hagen. To this inspiration, when he was about twenty-three, we can trace the growing interest which culminated in the great work of McLachlan's life, the "Monographic Revision and Synopsis of the *Trichoptera* of the European Fauna" (1874–1880), appearing between the ages of thirty-seven and forty-three. To his early training is due that rare breadth of knowledge and interest which made him so ready and learned a contributor to the discussions at our meetings—so valuable a helper to those who came to him for advice.

Robert McLachlan was a Fellow of the Society for nearly half a century, having been elected in 1858. He acted as Secretary from 1868 to 1872, as Treasurer from 1873 to 1875 and again from 1891 to the time of his death. He was President in 1885 and 1886. I have already spoken of his remarkable devotion to the Society. A certain apparent cynicism formed a veil which to a large extent concealed the real man from the sight of all but intimate friends. But there existed beneath a zeal and a strenuousness in disinterested service which is utterly inconsistent with cynicism. At times when the Society has been divided by conflicting opinion it has been my privilege to know that his own feelings were far less concerned with the subject of dispute or with the success of either party, than they were with the Society itself, in grave anxiety lest it should be injured by the struggle. In thus speaking, as is

only due, of his patriotic devotion to the Entomological Society of London, it is right to place beside it the "Entomologist's Monthly Magazine" which he served with equal zeal. He acted as an Editor from the very commencement in 1864, and upon the death of H. T. Stainton in 1902 became proprietor.

It is not necessary on this occasion to do more than allude to the long list of valuable memoirs, chiefly dealing with the Neuroptera, but by no means confined to this Order, which came from his pen. They were communicated to the scientific literature of many lands, and their author received from numerous scientific Societies on the Continent the highest honour which is in their hand to bestow. His election to the Fellowship of the Royal Society in 1877 took place in the midst of the years during which his Monographic Revision of the Trichoptera was being given to the world, and is an interesting indication of the instant recognition won by that great work.

I have not thought it necessary or even advisable on this occasion to repeat the whole of the interesting details of McLachlan's life and work which are to be found elsewhere.* Here, and in the special circumstances of his death while still holding the reins of office, I have preferred to speak chiefly of his relations to this Society, and of the circumstances which contributed to make him so valuable a member of our community. I trust I have been able to bring before you some of the reasons for the high honour that will ever be due to the memory of the warm friend the Society has lost.

Charles Golding Barrett joined the Society in 1884. By his death on December 11 we lose one of our most valued Fellows and an indefatigable worker. He was born at Colyton, Devonshire, on May 5, 1836, and entered the Civil Service in June 1856. He passed through the usual stages of promotion up to 1875, when he was appointed a Supervisor of Excise. In 1884 he was promoted to an Inspectorship, and was made a Collector of Inland Revenue at Lynn in July 1886. He was further promoted to a first-class Inspectorship

* "Entomologist's Monthly Magazine," July 1904, pp. 145–148. The Royal Society. Obituary. "Entomological News," September 1904, pp. 226, 227.

in October 1889, and subsequently, in August 1895, he became Collector of London South, where he remained until pensioned in April 1899. Throughout this long and varied official life his genial nature and kindliness of spirit endeared him to all his colleagues.*

The successive stages of such a career implied residence in different parts of the kingdom, bringing opportunities of studying the fauna and flora of varied districts, opportunities most welcome to this ardent naturalist.

In writing the following brief statement of Barrett's distinguished entomological career, I desire to acknowledge the assistance received from Commander Walker's sympathetic account in the "Entomologist's Monthly Magazine." The absorbing interest of Barrett's life became manifest in his boyhood. The first published observations which can be traced to his pen appeared in 1856, when he was twenty ("Entomologist's Weekly Intelligencer," vol. i, p. 165), and from this time until the end of his life he was a constant contributor to Entomological literature. His name appears in the Index of the "Entomologist's Monthly Magazine," as the author of no less than 330 separate communications. When we remember that this periodical only came into existence in 1864, we gain some idea of his energy and industry.

Our knowledge of the Lepidoptera in varied and widely separated parts of the British Islands has been greatly extended, as the late naturalist moved from one district to another:—to Dublin in 1859, to Haslemere in 1862, to Norwich in 1868, to Pembroke in 1875, to King's Lynn in 1886.

Barrett's great work on "The Lepidoptera of the British Islands" was begun in 1892, and all British naturalists will deeply regret that the guiding hand is no longer here to complete it. We shall miss his experience and control exactly where it will be wanted most—in the Micro-Lepidoptera. In fact many have regretted, as they saw the length to which re-description and re-illustration of things pretty well known

* I owe the information concerning Mr. C. G. Barrett's official career to the courtesy of the Editor of "The Civilian."

were carried in the earlier volumes, that the author had not reversed the method of his building, and begun with the Micro-Lepidoptera.

C. G. Barrett became a Fellow of our Society in 1884. He served on the Council in 1892–3, and again in 1900–01, and was a Vice-President in 1901. He was President of the South London Entomological Society in 1892, and was an important member of the editorial staff of the "Entomologist's Monthly Magazine" from 1880 until his death.

We deplore the loss of one who was ever ready to help his brother naturalists, one who invariably acted up to the high standard of those words which accurately express the living principle of our Society:—that we "are all members one of another."

We have also to mourn the loss of two Fellows who have joined our community within recent years:—E. G. J. Sparke, B.A., elected in 1897, and W. F. Urwick, elected in 1900. Both were well-known collectors of insects, comrades of Fellows, still happily with us, on those delightful occasions when friendships are made and deepened by companionship in the pursuit of a common interest.

Just as the year came to a close, on December 29, the Entomological world suffered irreparable loss in the death, in his seventy-third year, of one of the most distinguished of the twelve great names which stand at the head of our "List of Fellows," Professor Friedrich Moritz Brauer, of Vienna.

Brauer's first entomological publication, a revision of the genus *Chrysopa*, appeared in 1850, and in the course of the next few years he published numerous papers on the biology of the Neuroptera, rapidly rising into the front rank of the European students of that order.

In 1858 Brauer was attracted by the curious life-history of the Dipterous family, *Oestridæ*, upon which he carried out the most minute and painstaking investigations, culminating in the publication, in 1863, of his classical "Monographie der Oestriden." Even with his great ability the production of such a work would have been impossible had he not been almost entirely free from other pre-occupations. This fortunate result was rendered possible by his position as an Assistant

in the University Entomological Museum. In 1873 he was appointed Custodian of these Entomological Collections, and in 1874, Professor of Zoology in the University. At the time of his death he was a Director of the Naturhistorisches Hofmuseum.

Brauer's researches into the biology of the *Oestridæ* led him to found the two great divisions of Diptera—"Cyclorrhapha" and "Orthorrhapha," based upon the form of the pupa. Further researches into the metamorphoses not only of *Oestridæ*, but throughout the Order, led to the publication, in 1883, of a new "System of Diptera," which, with certain modifications, is still considered to be the best as yet brought forward.

Latterly Brauer turned his attention to the parasitic *Muscidæ* (*Tachinidæ*, etc.), and, in collaboration with Julius von Bergenstamm, published a work which marks a considerable advance in the classification of these groups.

The fundamental importance of Brauer's discoveries in two such sharply contrasted sections as the archaic Neuroptera and the comparatively modern, highly-specialized Diptera, fitted him in a very special way to study the broad and difficult question of the classification of the Insecta. His conclusions (Systematisch Zool. Studien, SB. Akad. Wien. xci. Abth. i. 1885, p. 374), "based upon recent advances in anatomy and embryology," were adopted in Dr. W. Hatchett Jackson's learned edition of Rolleston's "Forms of Animal Life" (Oxford, 1888). The most prominent feature of Brauer's classification is the splitting up of the Neuroptera into no less than 7 Orders out of the entire number of 17 adopted by him. An interesting discussion and criticism of the system appeared in Dr. David Sharp's contribution to the Cambridge Natural History (Insects, Pt. i., London, 1895, p. 175).

I have to thank Mr. J. E. Collin for much kind help in drawing up this brief account of the distinguished scientific man whose loss will be so deeply felt by biological Science throughout the world.

The Fellows of this Society will feel, in common with the members of other associations occupying this building, deep regret at the sad death of the late Resident Librarian, Mr.

William R. Hall. Long years of loyal and efficient service have left an enduring memory.

Before I proceed to the subject of my address there is one important point upon which I feel bound to warn not only this Society, but other Scientific Societies as well. I refer to the enduring qualities of the paper on which scientific publications are often printed, and still more emphatically the "paper" on which they are often illustrated. I allude especially to the so-called "art papers," assuredly named on the principle "ut lucus a non lucendo." The opaque, white, polished surface, which yields the most successful "half-tone" and "three-colour" printings, is at present only possible by means of a veneer of china-clay. Dust it is, and we are assured by experts that not many years will pass by before it succumbs to the fate which the highest authority tells us is in store for dust. For the purposes of advertisement, this is no disadvantage: the cynic may even maintain that the writings of the present day are, to the great benefit of the human race, recorded upon a fitting medium. But cynicism has no part in science, and every Fellow of this Society will agree that an age producing scientific records which cannot be made to endure, is an age to be rightly scorned by the generations of the future,—scorned as one that sunk to the lowest level of production, that, intellectually, owing its very existence to the noble standard reached by days yet earlier, took the benefits, and deliberately or carelessly neglected in like manner to assist its successors.

We have only to reflect upon the paramount importance of tradition in order to realize the weight of our responsibilities. Lloyd Morgan, discussing the trend of human development, speaks of a "transference of evolution from the individual to the environment," which "may leave the *faculty* of the race at a standstill, while the *achievements* of the race are progressing by leaps and bounds." * Or, again, he contrasts the progressive evolution of the intellectual and moral edifice of society with the cessation of evolution, perhaps even the declining level of "the human builders that contribute in each generation a few more stones to take a permanent place in the fabric." †

* "Habit and Instinct," London, 1896, p. 340. † *l. c.*, p. 345.

This great edifice was founded on oral tradition. Later on written tradition, and still later printed tradition took its place. When society comes to depend upon the one it in large part ceases to depend upon the others, and in changing its methods it is itself changed. Contrast, for instance, the period in the life of each one of us when we ceased to remember the affairs of daily life and gave our memory into the keeping of ink and paper. Although much was gained in the inevitable change, something was lost. Until recently there have been many people in this country, there are probably a few now, who, unable to read or write, can remember the details of complicated accounts in a manner astonishing and impossible to those who possess these accomplishments. We see that when society in any age has come to depend upon printing it will be through printing and not in other ways that it will contribute its chief share to the social edifice; and this is not a mere truism, for that age will have lost in large measure other powers which would have been developed in earlier times, powers which would still develop if printing did not exist.

Our American friends who enter so thoroughly into the essentials of a subject whenever they direct their attention to it, have not, so far as I am aware, made any determined attack upon this problem. Indeed, the majority of the scientific works, which they so freely and generously place at the disposal of students in other lands, are printed upon material,—I will not call it paper,—constructed of the felted fragments of wood, or of a thin paper backing overlaid and loaded with china-clay. The latter class are abnormally heavy, the former abnormally light.

This is a matter so important that it ought not to be left to the President of your Society to sound the warning. It is a matter which it would have been well if the Royal Society or the British Association had taken up years ago. It is not creditable to have left to our artist brethren a subject of such paramount importance to ourselves; for to them belongs the honour of having made the only serious attempts to improve our practice and to call attention to the evil.

To the trades concerned I would say that it is strange want

of enterprise to continue methods and use materials which only require to be thoroughly understood to insure a swift and sudden collapse for all but the most ephemeral purposes. I know no producer, scientific or other, whose self-respect would suffer the employment of materials, however good the effect, however low the cost, which would not last over so brief a period as five-and-twenty years.

I desire to thank Mr. Horace Hart, Controller of the Oxford University Press, and Mr. J. W. North, A.R.A., for the kind manner in which they have freely given information on this most important matter.

I now pass to the subject of my Address:—

"The bearing of the Study of Insects upon the question, 'Are Acquired Characters Hereditary?'"

To those who incline to criticize the subject of this Address as a raking of the embers of a dead and almost forgotten fire, I would reply that the controversy which sprang into sudden flame—in this country in the year 1887—is still a great memory. I trust that it will ever remain as a great memory. Of August Weismann it has been well said that "he awoke us from our dogmatic sleep." He made us realize that cherished convictions upon fundamental questions were based on nothing more solid than assumptions, and thus administered the most stimulating shock that has been received by the biological world since the appearance of the "Origin of Species."

It was impossible that a controversy of this magnitude could be conducted without frequent appeals to the Insecta. Their structures, functions, and instincts offered evidence so striking in character, and upon a scale so vast, that discussion was inevitably attracted again and again towards this centre. Indeed, the controversy would have been but one-sided, the conclusion unconvincing, had it been otherwise. At the same time discussion is and must be free and, being free, is almost necessarily scattered. To attempt therefore to disentangle from the mass and to present as a whole the evidence offered by the study of insects is of value in two ways. First, we are made to realize the importance of our study: by the contem-

plation of its relation to one majestic example we are prepared for the belief that our subject is essential for the solution of all the widest and deepest problems concerned with organic nature as a whole. Secondly, the attempt for the first time to marshal the whole of the evidence supplied by the study of insects will make it possible to strengthen and amplify certain parts, and thus render the whole fabric better balanced and more stable.

I should wish at the outset to express my indebtedness to the columns of "Nature," by means of which nearly the whole of the controversy has been followed. We are happy in the possession of a single journal in which discussions on general scientific questions are, by common consent, carried on.

"*Acquired Characters*" *defined.*—Before beginning a discussion it is important to remove any possibility of doubt or uncertainty as to the precise meaning of the terms which are employed. The word "acquired" as used in this controversy has been the source of as much confusion as the word "mimicry." Just as almost every one who hears of "mimicry" for the first time assumes that the word means a power of intentional imitation, so the inexperienced think that an acquired character is any new structure which a species has gained in the course of its history. "Why should we not consider every character acquired as an 'acquired character'?" they not unnaturally ask. And the answer is the same in both cases. Because these ordinary and untechnical words were given a special and technical meaning by the writers of memoirs which have become classical. In spite of all inconvenience both words are, in their scientific use, historic, and we must reckon with the fact that they have a special meaning which differs from their ordinary meaning.

Erasmus Darwin was, I believe, the first to use "acquired" in this restricted sense. "Fifthly," he says, "all animals undergo transformations which are in part produced by their own exertions, in response to pleasures and pains, and many of these acquired forms or propensities are transmitted to posterity."* Although Lamarck made a preliminary state-

* "Zoonomia," 1794. Quoted by Professor H. F. Osborn, "From the Greeks to Darwin." New York, 1894, p. 145.

ment of his views on evolution in 1802, the celebrated "Philosophie Zoologique" was not published until 1809, fifteen years after the appearance of the "Zoonomia," and it is uncertain whether the author of the later work had ever seen the earlier treatise. Professor Osborn concludes upon the whole that he had not (*l. c.*, pp. 152—155). However this may be, the technical use of the words "acquired characters" is chiefly due to his memoir. The essential passages are the two following Laws of Lamarck:—

"*Première Loi.*—Dans tout animal qui n'a point depassé le terme de ces developpements, l'emploi plus fréquent et soutenu d'un organe quelconque, fortifie peu à peu cet organe, le developpe, l'aggrandit, et lui donne une puissance proportionnée à la durée de cet emploi; tandis que le défaut constant d'usage de tel organe, l'affaiblit insensiblement, le détériore, diminue progressivement ces facultés, et finit par le faire disparaître."

"*Deuxième Loi.*—Tout ce que la nature a fait *acquérir* ou perdre aux individus par l'influence des circonstances où leur race se trouve depuis longtemps exposée, et par conséquent par l'influence de l'emploi prédominant de tel organe, ou par celle d'un défaut constant d'usage de telle partie, elle le conserve par la génération aux nouveaux individus qui en proviennent, pourvu que les *changements acquis* soient communs aux deux sexes ou à ceux qui ont produit ces nouveaux individus." *

Opposite to the characters which Lamarck spoke of as "*acquired*" are the characters which may be called *constitutional*, *congenital*, *genetic*, *inborn*, *innate* or *inherent*. Other names have been specially proposed in order to render apparent the distinction between these two classes of characters. Weismann employed terms which set forth their different origin. The *inherent* he called *blastogenic*, expressing an origin that lay far back in germ-cell from which the individual arose. *Acquired* characters he called *somatogenic*, to express a later origin due to circumstances which had affected the body-cells.

* "Philosophie Zoologique," tome i. p. 235, Édition Savy, 1873: quoted by Professor E. R. Lankester in "Nature," vol. xli, 1890, p. 415. There had been a tendency in the discussion on this subject to protest against the restricted application of the word "acquired," and it was assumed that the use was quite recent, and in fact due to Professor Weismann himself. Professor Lankester shows the error of this assumption.

The word *centrifugal* suggests characters developing from within rather than as impressed from without: *centripetal* conversely suggests characters impressed upon the individual from without, characters which are not the outcome of internal causes.* Acquired structural changes have also been spoken of as *modifications*, the term *variation* being restricted to characters of germinal origin.†

All the terms suggested for these two classes of characters convey something of a definition. Thus the brief convenient definition of acquired characters as "those modifications of bodily structure or habit which are impressed on the organism in the course of individual life" ‡ is obviously suggested more or less completely by one set of terms, and "those characters or properties with which the individual is originally endowed" § by the other set. Another attempted definition of an acquired character is as follows :—"Whenever an organism reacts under an external force, that part of the reaction which is directly due to the force is an acquired character." || And although it may be impossible entirely to unravel the one part from the other, certain elements may easily be discriminated. For instance, the *starting* of the reaction as contrasted with the sequence of events which make up the reaction itself is obviously an acquired element, and those who maintain the hereditary transmission of acquired characters are required to prove that a reaction which can only be started by an external force in the parent, starts without this stimulus in the offspring.

We owe another definition to Mr. Francis Galton :—"Characters are said to be acquired, when they are regularly found in those individuals only, who have been subjected to certain special and abnormal conditions." **

Professor Lloyd Morgan's definition conveys nearly the same idea :—"When the complex of stimuli, which constitute the normal environment, are sufficiently altered (to upset that

* "Theories of Heredity," in the "Midland Naturalist," Nov. 1889.

† Prof. J. Mark Baldwin, "A New Factor in Evolution," in the "American Naturalist" for July 1896.

‡ Professor C. Lloyd Morgan in Baldwin's "Dictionary of Philosophy and Psychology," New York, 1901, vol. i, p. 10.

§ E. S. Goodrich, *l. c.*, p. 10.

|| "Nature," vol. li, 1894, p. 55.

** *Ibid.*, p. 56.

balance established between environment and innate qualities resulting in the production of a normal individual) to produce an appreciable change, such a modification or 'difference' may be called an acquired character." *

Such results of abnormal conditions undoubtedly supply extremely striking examples of acquired characters, but it is, I submit, a mistake to make too much of abnormality, or to import it into a definition. Some of the most marked and certainly the most easily studied and tested of acquired characters are the differences between the effects of alternative environments, all of which are normal, upon the individuals of a single species. The green colour of a larva of *Amphidasys betularia,* if fed upon broom, is an acquired character, as is the dark colour it would assume upon oak, etc. I think therefore that a more satisfactory definition of at any rate a large class of acquired characters may be framed as follows:—"Whenever change in the environment regularly produces appreciable change in an organism, such difference may be called an acquired character."

Sir Edward Fry has objected to Mr. Galton's definition,—and his objection would equally apply to that which I have suggested above—that "the possibility of inheritance is excluded by the definition, and the inquiry whether acquired characters are inherited is impossible." †

This appears to me to be only a verbal difficulty. Before attempting to prove whether a certain class of characters can be inherited, it is essential to be able to decide whether a given character which it is proposed to test belongs to the class. If a satisfactory criterion can be reached we can proceed with the test even though the name "acquired" be by our definition denied to the character after transmission by inheritance. The interest of the result would remain all the same. If the character were there—appreciable, measurable,—the effects would be incalculable in their importance, and would not be diminished one iota by the consideration that the name would no longer apply. Sir Edward Fry's criticism does indeed

* Baldwin's "Dictionary of Philosophy and Psychology," p. 10.

† "Nature," vol. li, 1894, p. 198. See also Professor Lankester's reply to the criticism, on p. 245.

suggest a change—and I think a desirable change—in the statement of the problem. For the question, "Are acquired characters hereditary?" it would be more accurate to substitute "Can the acquired characters of the parent be handed down as inherent characters in the offspring?"

It is in no way necessary that the acquired elements of a character should be disentangled from the inherent elements, so that we can prove the character as a whole to be dependent upon a controllable external cause, and therefore itself controllable. In fact we speak of a character as "acquired" just as we speak of an article as "manufactured," although the result itself is a complex of the properties of natural substances and of changes introduced by art.*

Lamarck's Second Law a contradiction of his First Law.—Before leaving these general introductory considerations and proceeding to weigh the evidence offered by the insect world, it is of importance to demonstrate that there is an inconsistency in the teaching of Lamarck and his followers which, startling as it is, was never noticed until pointed out by Professor E. R. Lankester in 1894.†

"Normal conditions of environment have for many thousands of generations moulded the individuals of a given species of organism, and determined as each individual developed and grew 'responsive' quantities in its parts (characters); yet, as Lamarck tells us, and as we know, there is in every individual born a potentiality which has *not* been extinguished. Change the normal conditions of the species in the case of a young individual taken to-day from the site where for thousands of generations its ancestors have responded in a perfectly defined way to the normal and defined conditions of environment; reduce the daily or the seasonal amount of solar radiation to which the individual is exposed; or remove the aqueous vapour from the atmosphere; or alter the chemical composition of the pabulum accessible; or force the individual to previously unaccustomed muscular effort or to new pressures

* For an interesting discussion on the relation between "acquired" and "genetic" characters see Adam Sedgwick's Presidential Address to Section D of the British Association at Dover (Report 1899, pp. 759–766).

† "Nature," vol. li, 1894, p. 102.

and strains; and (as Lamarck bids us observe), in spite of all the long-continued response to the earlier normal specific conditions, the innate congenital potentiality shows itself. The individual under the new quantities of environing agencies shows *new* responsive quantities in those parts of its structure concerned, new or *acquired* characters.

"So far, so good. What Lamarck next asks us to accept, as his 'second law,' seems not only to lack the support of experimental proof, but to be inconsistent with what has just preceded it. The new character, which is *ex hypothesi*, as was the old character (length, breadth, weight of a part) which it has replaced—a response to environment, a particular moulding or manipulation by incident forces of the potential congenital quality of the race—is, according to Lamarck, all of a sudden raised to extraordinary powers. The new or freshly-acquired character is declared by Lamarck and his adherents to be capable of transmission by generation; that is to say, it alters the potential character of the species. It is no longer a merely responsive or reactive character, determined quantitatively by quantitative conditions of the environment, but becomes fixed and incorporated in the potential of the race, so as to persist when other quantitative external conditions are substituted for those which originally determined it. In opposition to Lamarck, one must urge, in the first place, that this thing has never been shown experimentally to occur; and in the second place, there is no ground for holding its occurrence to be probable, but, on the contrary, strong reason for holding it to be improbable. Since the old character (length, breadth, weight) had not become fixed and congenital after many thousands of successive generations of individuals had developed it in response to environment, but gave place to a new character when new conditions operated on an individual (Lamarck's first law), why should we suppose that the new character is likely to become fixed after a much shorter time of responsive existence, or to escape the operation of the first law? Clearly there is no reason (so far Lamarck's statement goes) for any such supposition, and the two so-called laws of Lamarck are at variance with one another."

These passages have been quoted at length because they

apply not only to the thought of Lamarck but to those of many modern naturalists as well, and because, so far as I am aware, no attempt has been made to meet the objection. In its most condensed form the argument may be stated thus:—Lamarck's "first law assumes that a past history of indefinite duration is powerless to create a bias by which the present can be controlled; while the second assumes that the brief history of the present can readily raise a bias to control the future.*

I now pass to the discussion of evidence derived from the study of the insect world.

I do not propose to multiply examples, but shall be content with a few of those which seem sufficiently well adapted to illustrate the main lines of evidence. They have been chiefly, but by no means invariably, selected from the Lepidoptera. This is merely due to the accident that my experience has been chiefly gained in this Order, and not because the examples are in any way more suitable or convincing than those of other Orders. As regards the most interesting part of the discussion, that relating to instinct, the most striking examples have of course been chosen from the Hymenoptera.

The origin of the pupal groove which receives the silken loop in Pierinæ, etc.—If we examine the dorsal surface of such a Pierine butterfly as *Pieris brassicæ* or *rapæ* it is at once seen that the first abdominal segment is traversed by a strongly marked line parallel with its posterior boundary. This character is so well marked that it presents all the appearance of a morphological feature.

A study of the living suspended pupa shows that the line is formed by the approximated lips of a groove which receives the silken loop or "girdle" as it is often called. Longitudinal vertical sections of the dorsal cuticle are of course transverse to the line, and reveal the fact that the bottom of the groove is specially thickened. Here was a feature at first sight strongly suggestive of the mechanical effects of linear pressure, pointing to an origin in a kind of mutilation performed by the silken cord upon the soft freshly-exposed surface of the pupa. When I found that removal of the loop

* "Nature," vol. li, 1894, p. 127.

before pupation, but after the period at which the larva could spin another, did not alter the normal appearance of line and groove in the resulting pupa, I was for the moment convinced that acquired characters are hereditary. But fortunately the inquiry did not come to an end at this point. It was observed that the Pierine pupæ which furnished the material for experiment (*P. brassicæ* or *P. rapæ*) invariably suspended themselves either horizontally or vertically with the head upwards,—*never* vertically with the head downwards. Several larvæ of *P. brassicæ* had fixed themselves in the normal vertical position preparatory to pupation, upon a sheet of glass. Before pupation, but after the period at which the larvæ could fix themselves afresh or indeed make any attempt to spin, the glass sheet was rotated through half a circle, so that all the larvæ came to be suspended head downwards. In this position they were compelled to pupate. The condition of the resulting pupæ clearly refuted the hypothesis of a mechanically-created groove and thickening, caused by the cutting into and pressure upon the soft yielding cuticle. For in the vertical position with head downwards the pupa slips through the silken loop beyond the position of the groove, so that the pressure has to be borne by an unprepared part of the cuticular surface. Upon the mechanical hypothesis, we should expect that the fresh surface would gain some measure of resistance from the strain; but on the contrary the pupæ were all hopelessly deformed and the imagines,—if indeed they could have emerged at all,—would have been incapable of flight.* It is evident that from the very beginning the loop has been accompanied by a sufficient strengthening of the part of the surface exposed to its pressure as soon as the larval skin was thrown off.

The silken loop together with the attachment of the posterior extremity of the pupa is in all probability the persistent trace of a vanished cocoon, and we may imagine the selective process which made good each step on the road of gradual

* This experiment has not been published hitherto. It was however described and the pupæ exhibited in the discussion in Section D of the British Association at Manchester, on Monday, Sept. 5, 1887. See Report, p. 755.

transformation. A cocoon is one form of passive defence, cryptic colouring is another, although the two are commonly combined, especially in cocoons built to endure for comparatively long periods, including the times of special stress,—the winter of the northern belt, the dry season of more southern latitudes. The original decline of the cocoon was probably favoured by a short pupal period falling wholly within the time of least stress,—summer or the wet season. When the cryptic colouring of the bare pupal surface is as effective for concealment as that of the cocoon, it presents certain advantages over the latter. The secretion of a large quantity of material is unnecessary and tell-tale movements in the period before pupation are greatly reduced. These benefits are conferred when the concealment afforded is equal; but the pupal cuticle lends itself to certain forms of cryptic defence much more freely and completely than the walls of the cocoon:—to the production of angular shapes and of smooth or polished surfaces, to the attainment of varied colours and the perfect gradation of tints, above all to the power of individual colour-adjustment. This latter culminating effort of adaptation—so commonly possessed by larvæ and exposed pupæ—is apparently extremely rare in the cocoon. Indeed the only positive evidence of its existence is supplied by *Hylophila* (*Halias*) *prasinana*,* and even in this case it would be satisfactory to repeat the experiments on a far larger scale than has been as yet attempted. The transition is easy from a loose and open cocoon with apertures through which the cryptic colours of the enclosed pupa could play their part in defence, through stages in which the latter element becomes more and more important as the cocoon progressively diminishes, to the climax when the almost invisible remnants of the silken covering are retained as supporting structures merely. In all except small and light pupæ a point would be reached, at a greater or less distance from the climax, when some special strengthening of the cuticle exposed to the strain became the indispensable condition of further advance. Thenceforth further reduction and further strengthening would proceed together, the existing groove and thickening being but the

* Trans. Ent. Soc. Lond., 1892, pp. 448–451.

concentration of the broader band of pupal tissue specially prepared to meet the pressure when it first became a danger.

Comparison with the pupæ of some of our common British Geometræ supports the hypothesis set forth above; for it is seen that very similar changes have independently occurred, and occurred so recently that the essential stages are still preserved. Furthermore, they are invariably met with in species which have a short pupal period passed in the warmer months of the northern year. *Eugonia quercinaria* spins a loose and open cocoon, within which the chrysalis, as well as the larva before pupation, develops an effective cryptic colouring.* Both larva and pupa are freely exposed to view through chinks in the scanty network and between the imperfectly united leaves. *Uropteryx sambucaria* constructs a slight hanging cocoon, affording very little concealment. The enclosed pupa bears a marked cryptic appearance, while the only experiment which has been made indicates the possibility of a well-developed power of individual colour adjustment.† Both these species, and especially the last, have long since reached the stage at which the reduction of the cocoon became advantageous. In the genus *Zonosoma* (*Ephyra*) we independently arrive at the same climax of reduction attained in the *Pierinæ*, etc., the cocoon being represented by a supporting loop and the means of fixation of the posterior extremity.‡ No search has been made, so far as I am aware, for a special strengthening of the cuticle upon which the loop presses, but it is probable that nothing of the kind is required by these small light pupæ. The exposed Ephyrid chrysalis is fully as cryptic as that of the average butterfly, but it lacks the power of colour adjustment. When the Ephyrid larva is dimorphic, green or brown, the colour of the pupa corresponds to that of the larva from which it developed.§

* Trans. Ent. Soc. Lond., 1885, p. 319.

† See "Colours of Animals," London, 1890, pp. 111, 112. Only one example was placed on white paper before pupation. Although the resulting chrysalis was very pale and strikingly different from the ordinary appearance, the evidence is quite insufficient, and it is much to be hoped that the experiment will be repeated upon a large scale.

‡ Trans. Ent. Soc. Lond., 1884, p. 57.

§ Trans. Ent. Soc. Lond., 1884, p. 51; Phil. Trans. Roy. Soc., vol. 178 (1887), B., pp. 437, 438.

Such correspondence has not been observed in any other Lepidopterous insect.

If we take into account the fact that *Zonosoma* (*Ephyra*) is a characteristic Geometrid genus, although its method of pupal suspension is unique in a family whose species make cocoons or bury, we may feel confident that it has been descended from cocoon-making ancestors, and that *Eugonia quercinaria* and *Uropteryx sambucaria* give us a clear idea of the steps by which the reduction was effected.

The effect of Gravity upon the shape of suspended pupæ such as those of the Nymphalinæ.—Every naturalist who has watched the pupation of a Vanessid must have observed the extraordinary mobility of the abdominal region of the freshly-exposed chrysalis. Movements of remarkable amplitude take place in every direction, and especially in the dorso-ventral plane, these latter being essential for the withdrawal of the posterior segments from the larval skin and the remarkable feat of attachment to the silken boss close to the point from which the skin itself is hanging. Success is only rendered possible by the remarkable contractile power of the intersegmental muscles along the median ventral area. These, by their contraction, keep the rigid hook-armed apex of the abdomen firmly pressed to the outside of the larval skin up which it is being forced, and enable it to press down or push aside any of the stiff spines which oppose the movement: these finally bring it to the small silken boss which alone provides a secure basis of attachment for the terminal hooks. For this purpose the ventral muscles require to be far stronger than those of any other region, and we invariably find that they entirely overbalance the dorsal intersegmental muscles in pupæ which have been produced on the floor of the breeding-cage. In such pupæ the abdominal segments are curved round towards the ventral side, so that the long axis of the apical part forms at least a right angle with that of the thoracic region, and this attitude becomes stereotyped with the hardening of the pupal cuticle and the consequent loss of all power of dorso-ventral movement. These free pupæ form a striking contrast with the normal attached individuals in which the long axis of the abdominal segments

is nearly in the same line with that of the thoracic. Suspension by the posterior apical hooks and the assumption of a form in which the long axis of the body is nearly in one line, is very ancient, dating back to the common ancestor of a number of closely-related species. For a countless number of generations the soft and yielding Vanessid pupa has been subjected to the strain of gravity and has responded by the production of a definite shape, viz. one in which the long axis is parallel with the line of force. And yet not a trace of any hereditary effect is manifest. Remove the strain and the individual is free, unbiassed by the forces exerted upon unnumbered ancestors, to assume an entirely different shape.

Vanessid pupæ alone, so far as I am aware, have been studied from this point of view. Figures of other suspended Nymphaline pupæ however indicate that all do not yield equally to the strain, although I believe that all are to some extent affected. The pupæ of the *Argynnidæ* contrast in an interesting manner with those of the *Vanessidæ* in this respect. The strongly-curved pupa of *Argynnis aglaia* figured by W. Buckler * was probably supported wholly or in part by a leaf, as is suggested not only by the shape but the plane of the surface of attachment, as shown in the figure, and to some extent by the description.

Variable Protective Resemblance in Insects.—The power which it is now known that many larvæ and pupæ possess of changing their colour into correspondence with the tints of each one of several possible environments has been thought to favour the Lamarckian interpretation of the origin of variation. Thus the late George J. Romanes said of the evidence which had been brought forward to prove the power in question :—" It has always appeared to me that the experiments themselves are among the most valuable which have hitherto been made regarding the causes of variation," † an opinion due, as the writer states, to his acceptance of the " Lamarckian conception."

On the other hand, I have never doubted that the results are in the nature of a climax rather than a foundation, that

* Ray Society, "Larvæ of British Butterflies and Moths," vol. i, Plate X, fig. 3*b*, 1886.

† " Nature," vol. xxxviii, 1888, p. 364.

they represent the highest achievement of natural selection in the protective colours of insects. If these variable colours represented the beginnings of ordinary fixed colour variations the species would lose and not gain by the change. The essence of the protective value is the power of being concealed in each of several different environments, and hereditary transmission of the results would only injure the individuals of the next generation. The intricacy of the processes by which the stimulus gives rise to each appropriate colour-effect is no difficulty to the interpretation based on natural selection—"an agency capable of dealing with complex physiological relationships in precisely the same way that it deals with all other kinds of variations." *

The barren conception of "self-adaptation,"—the hypothesis that organisms possess a constitution which compels them to react adaptively, breaks down when we find the adaptation is only possible by means of a specialized and complex train of physiological sequences.

We must remember that the species we investigate are "heirs of all the ages," thoroughly inured to experimental research, past masters in the art of meeting by adaptive response the infinite variety of stimulus provided by the environment. If we remember this we shall always be on our guard against a too hasty interpretation based on the fundamental properties of protoplasm.†

The hypothesis that organisms are so built that they must produce useful variations, seems to be little more than the old "internal developmental force," or "innate tendency towards perfection," in a modern dress. Furthermore, a consideration of the essential meaning of adaptation proves the futility of any such attempt at explanation. The ultimate object of adaptation is to obtain food, to escape enemies, or to subserve reproduction. The most conspicuous adaptations manifested by an individual are relative to the condition of the organic environment with which its contact is in many respects

* Professor Meldola in "Nature," vol. xxxviii, 1888, p. 389. See also Professor Meldola's Presidential Address in Proc. Ent. Soc. Lond., 1896, pp. lxx, lxxi; and the first scientific paper published by him, viz. Proc. Zool. Soc. 1873, p. 153.

† "Nature," vol. lxxi, 1905, p. 244.

irregular, uncertain, or even wanting. Caterpillars are provided with beautiful protective adaptations, but the successful individual never comes into contact with an enemy. But there is an environment which the organism cannot avoid, —the physico-chemical stimuli of climate and food ; and it is presumably here, in the inorganic conditions of life, that the influences which bear a pre-eminent part in evoking useful variations are supposed to reside. So that stimuli provided by one form of environment are looked upon as the direct causes of adaptations which are essentially related to another and very different environment.*

The Instincts of Insects.—Those who advocate the hereditary transmission of acquired characters have made great use of the argument that the wonderfully complex and precise adaptive instincts of insects require for their production the accumulation of experience and of effort through many generations. Only by such transmission, they maintain, is it possible to understand such development.

It is safest to begin with a definition, and I accept the brief, convenient and in my opinion entirely accurate statement of Lloyd Morgan:—" Instinct depends on how the nervous system is built through heredity; while intelligence depends upon how the nervous system is developed through use." †

We observe in the first place that the Lamarckian interpretation places the more difficult phases of the evolution of instinct —the phases when it was not instinct at all but something much higher—in some remote epoch of the past, and at a lower level of progress. In such times, *ex hypothesi*, the less developed and presumably less efficient brains of insects did by the intelligent use of experience what they now do mechanically by instinct. This is an inversion of the probable course of evolution: the less efficient instrument has assigned to it by far the more difficult task.

Apart from this *primâ facie* objection there are solid grounds for the belief that the exquisitely perfect operations of insects with which we are familiar arose as instincts, as

* The substance of the argument set forth in this paragraph was published by the writer in "Nature," vol. l, 1894, p. 445.

† "Animal Behaviour," London, 1900, p. 120.

instincts were gradually perfected, and that intelligence never came into the history at all.

It is not from the insects which have had the most varied experience of enemies, most opportunity of learning by contact with danger how to avoid them, and thus of developing their nervous systems through use, it is not from these that existing forms have been descended, but from precisely those which have had the least experience. Even for ourselves experience is spoken of as "the stern guide." To an insect she is apt to be so stern as to lose all her educational value. The less an insect sees of her the better the chance of existence and of representation in the generations of the future. The prime necessity for an insect, as for all animals which cannot in any real sense contend with their foes, is to avoid experience of them altogether.*

This is an argument with the broadest possible application to all Orders of insects. To the adaptive movements of a beetle which when disturbed falls to the ground, draws in its limbs and antennæ, and looks exactly like a little lump of earth; to the alertness of a fly to take wing before an enemy is within striking distance; to the perfection of all such means of defence in insects, and they are numberless, we may apply the words of Browning:—

> "Oh, the little more, and how much it is!
> And the little less, and what worlds away!"

It is all the difference in fact between success and failure, between life and death. Comparatively rarely are the conditions of the struggle such as to admit of partial failure or of improvement by experience.

One special reason for the passive means of defence adopted by the vast majority of insects is to be found in the peculiar dangers of their structure. Especially is this true of larvæ, with their hæmolymph contained in freely communicating

* This argument was brought forward by the present writer in the discussion on "Are Acquired Characters Hereditary?" at the meeting of Section D of the British Association, at Manchester, Sept. 5, 1887 (Report, p. 755). No part of the discussion is published. The argument is however briefly stated in Proc. Boston Society of Nat. History, vol. xxvi, 1894, p. 391, and also quoted in "The Zoologist," Dec. 1900, pp. 551, 552.

cavities, and subject to the pressure of muscular body-walls. Hence an insignificant injury may often cause death or imperfect development from the quantity of fluid which is lost. "It is, I believe, in consequence of these facts that the various means of protection in larvæ are almost always of a passive kind. . . . Nearly all the means of defence against . . . enemies [other than ichneumons, etc.] are such as tend to prevent the larva from being seen or touched, rarely such as to be of any avail when actually attacked. There may be various changes in the mode of defence, but the object is always the same—to leave the larva untouched, a touch being practically fatal." *

Let us consider for a moment the mental operations involved in the act of profiting by experience. Consider, for instance, Mr. A. H. Hamm's interesting observation—since abundantly confirmed by the testimony of many naturalists—that the vast majority of the individuals of *Hybernia leucophæaria* rest with the body horizontal, thus bringing the lines of the wings into parallelism with the dark shadows in the vertical cracks of the oak-bark.† An individual which adopted a different attitude and rested so as to cause the main lines of its pattern to cut the main lines of its environment might indeed escape by flight; but can any one really believe that a moth, or any of the ancestors of moths, could associate the special disturbance and danger to which it had been exposed with the special attitude it had assumed, and would as a result of that association begin to make changes in its attitude? It is easy to speak of improvement by experience, perhaps easy to think of the progress of an insect's education under the sternest of teachers: easy so long as we confine ourselves to generalities. Attempt to picture the process in a definite case, and apply it, as I have done, to account for the growth of some special protective adaptation, and it is instantly borne in upon us that we are placing on insect psychology a load it is altogether unable to bear.

The Cocoon-making Instinct.—There are however numberless examples in which it is impossible that improvement could

* Trans. Ent. Soc., London, 1885, pp. 321–323.

† Proc. Ent. Soc. Lond. for March 19, 1902, p. xv.

be thus effected, even if insects did possess the requisite brains, that is unless we also accord to them the gift of prophecy. These are the cases in which instinct prepares for the dangers of a struggle at some future time, when the organism which manifested the instinct will have changed its form, and become incapable of making further changes in the means of protection, and indeed as a rule entirely incapable of making any defence.

Consider, for example, another observation made by Mr. Hamm in July 1900, upon the cocoons of *Malacosoma neustria* spun within the leaves of black-currant and apple in his garden at Oxford. These he found to be opened by birds, probably sparrows, which had pecked a hole in the leaf, thus breaking through the cocoon at its thinnest point,* and abstracted the chrysalis.

A still more convincing example is to be found in the origin and maintenance of the instincts involved in the construction of a freely exposed yet admirably concealed cocoon on bark. Think of the natural cracks just filled up, of tunnels closed flush with the surfaces around, of the resemblance to excrescences or ridges which appear perfectly natural upon bark. Considering not only the forms but the colours and texture of the external surface, we recognize at once that such structures are the product of a highly perfected group of instincts. At first sight indeed the case seems to prove too much; for it may be thought that such cocoons are so completely hidden as to defy the sharpness of any enemy however acute, and

* The cocoons were exhibited to the Society on March 19, 1902. See Proc. Ent. Soc. Lond. 1902, p. xv.

Mr. W. Holland many years ago showed that birds attack in this particular way, but his observation was upon larvæ spun between leaves, and not pupæ; and the latter are specially suited for enforcing the present argument. Mr. Holland's observation is as follows:—

"On the 6th of this month [June 1890, near Reading] Captain Robertson and I went to get some larvæ of *populeti* from some low trees of *Populus tremula* which were covered with that species. Captain Robertson had picked off about 100 larvæ the night before; but this morning, when we arrived at the trees, we found some starlings had also discovered the caterpillars, and had gone over the trees systematically from branch to branch, pecking a hole in one side of the spun-together leaves, and drawing out the caterpillar, and so nearly had they cleared them all off, that we had much trouble to find a dozen. We caught the birds in the act, and although they had so nearly finished their feast they were very unwilling to go, and loudly objected to our disturbing them."—"Entomologist's Monthly Magazine," 1890, p. 216.

believers in natural selection may properly be asked to bring evidence of the existence of a struggle in which the high elaboration of the instincts in question is a defence. There is no difficulty in meeting the challenge, for specially directed observation at once reveals the existence of a keen struggle in which the concealment of the cocoon is the criterion of life or death.

My attention was first directed to this particular aspect of the struggle for existence in insects, on April 12, 1893, when I found on the bark of *Populus nigra*, near Yoxford, Suffolk, a cocoon of *Dicranura bifida* which had been opened by some enemy, and the pupa removed. The observation is, I believe, a common one, in fact Commander Walker and Mr. Holland inform me that it is usually difficult to find cocoons of this species which have not been thus attacked. Nevertheless, for the sake of those who have not had the experience, I think it is worth while to re-describe the evidence which certainly justifies us in inferring that "an enemy hath done this."

"The edges of the opening were still brown and fresh, as was the interior of the cocoon; and the larval skin remained fresh and untouched inside. The opening was in the middle of the exposed surface and not at one end, as it is when the moth emerges. Besides, the cocoon had been opened and cracked by a blow from some hard object, such as a bird's beak, and the sharp irregular margins were quite different from those of the natural opening made by the moth, doubtless by means of a corrosive fluid, as in the allied species, *Dicranura vinula*, which Mr. O. H. Latter has recently shown to secrete caustic potash for this purpose. Furthermore, the moth emerges far later in the year, and, had it emerged at an exceptional time, the empty pupal skin would have been left behind in the cocoon. We may therefore safely assume that the opening was the work of an enemy, and, as the cocoon was five feet from the ground, it was probably due to some tree-creeping, bark-exploring species of bird. . . . It is probable that the attention of the enemy is directed to any cocoon-like object by the sense of sight, and that the object is then tapped, and, if found to be hollow, opened and the pupa devoured." *

* "The enemies of Lepidopterous pupæ enclosed in bark-formed cocoons."—"Science," xxiii, 1894, p. 62. The date of the observation is

The cocoons of *bifida* are spun in the autumn, but the attack did not take place for several months. The example is probably typical in this respect. The procryptic preparation of the autumn is the adaptation by which the average numbers of the species are kept up in spite of ceaseless bark-hunting during the months when the trees are leafless and food is scarce. The Lamarckian interpretation fails to account for the cocoon-making instinct for two very sufficient reasons : first, a chrysalis is incapable of learning by experience how to improve anything,—even more obviously incapable of learning concerning a structure which it never makes. Secondly, however intelligent a chrysalis may be, the experience itself is of such a nature that its stores of learning cannot be handed down to posterity.*

If the Lamarckian interpretation of the cocoon-making instinct must inevitably fail, as I think we shall agree it must, what is there to put in its place? Those who believe in the efficiency of Natural Selection in evolution will probably regard the instinct of building these beautifully-adapted structures as the outcome of countless generations during which the attacks of enemies have been, on the whole, more successful against the products of less perfected instincts and less so against those of the more perfected. They will further suppose that the increasing perfection in instinct has acted selectively on enemies, sharpening their faculties, until, by action and reaction, the present high level of constructive skill has been reached, and is maintained.

The Instincts of the Hymenoptera.—No discussion of instinct would be in any way complete without a consideration of the most wonderful examples of all, viz. those manifested by the Hymenoptera. The instincts of the Fossorial Aculeates in providing for their larvæ,—studied with all the sympathy of a born naturalist and described by a master of style,—have

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erroneously given as the year of issue instead of 1893. Some of the later sentences of the same communication are also quoted with slight modification on the present occasion.

* This argument also is briefly stated in the "Proc. Boston Soc. Nat. Hist.," vol. xxvi, 1894, p. 391, and quoted in "The Zoologist," Dec. 1900, pp. 551, 552.

formed the foundation of a gigantic speculative edifice. The controversy has in reality been a three-sided one.

I. First, we have Fabre disbelieving in evolution altogether, and adducing evidence that his favourite insects have not gained their wonderful instincts by progressive change pointing out that they perform their duties under some stimulus which to them is imperative, whether the object of their pains be achieved or not: arguing, for example, that in those that feed their larvæ from time to time, the stimulus to enter and deposit the insect food is not the young larva itself but the door of the tunnel.

II. Secondly, Lord Avebury and the late George J. Romanes have argued in favour of evolution by a gradual education, finally inherited as instinct. There is reason to believe that Darwin accepted the same view. He certainly never opposed it. Lord Avebury alludes to the letter written to Fabre, in which Darwin "refers to the great skill of the Gauchos in killing cattle, and suggests that each young Gaucho sees how others do it, and with a very little practice learns the art." *

Lord Avebury identifies himself with this view, which, indeed, he had himself set forth in the "Contemporary Review," in 1885. Concerning the instinct of the *Ammophila* to sting the ganglionic centres of its caterpillar prey, he suggests that "during these long ages they may have gradually learnt the spots where their sting would be most effective, and . . . so have gradually acquired their present habits." † He finally concludes that "these remarkable instincts" are "the result of innumerable repetitions of similar actions carried on by a long series of ancestors." ‡

George J. Romanes in reviewing Lord Avebury's book goes much further:—"Here, by the way, we have an excellent instance of the difficulty which we so often encounter in the domain of instinct, when we relinquish the so-called Lamarckian principle of the inheritance of acquired characters. The hypothesis in question goes upon the supposition that

* Sir J. Lubbock, "On the senses, instincts, and intelligence of animals, with special reference to insects." London, 1888. Internat. Sci. Ser., p. 248.

† p. 248. ‡ p. 252.

some of the ancestors of the Sphex were intelligent enough to notice the peculiar effects which followed upon stinging insects or caterpillars in the particular regions occupied by nerve-centres, and that, in consequence of being habitually guided by their intelligence to sting in these particular regions, their action became hereditary, *i.e.* instinctive. But if, in accordance with post-Darwinian theory, we relinquish this possible guidance by intelligence, and suppose that the whole of this wonderful instinct was built up by natural selection waiting for congenital (*i.e.* fortuitous) variations in the direction of a propensity to sting, say, the nine nerve-centres of a caterpillar —then it surely becomes inconceivable that such an instinct should ever have been developed at all." *

Eimer is even more rash in his statements:—"This is one of the most marvellous instincts that exists; since the wasp operates on various larvæ with nervous systems of various forms, she must effect the paralysis in various ways, and even apart from this, she makes a physiological experiment which is far in advance of the knowledge of man. . . . It may be suggested that the wasp only paralyzed the larvæ in order to carry them more easily; but even if this were the case, she must, since she now invariably acts in this way, have drawn a conclusion by deductive reasoning. In this case it is absolutely impossible that the animal has arrived at its habit otherwise than by reflection upon the facts of experience."

Mr. and Mrs. Peckham make the following comment upon this wild passage from Eimer:—"One can hardly be expected to take such statements seriously, since it is certain that the writer has no knowledge of the life-histories of these insects." †

III. Thirdly, there are those who believe that the instincts in question are to be explained by the operation of natural selection upon hereditary nervous mechanisms, who believe that the Lamarckian principle of the hereditary transmission of education has never come into the history at any stage. Fabre's observations are quite consistent with this view; in

* "Nature," vol. xxxix, 1888, p. 77.

† "The Instincts and Habits of the Solitary Wasps," by George W. and Elizabeth G. Peckham, Madison, Wis., 1898, p. 221.

fact it would almost appear that Darwinian evolution as apart from Lamarckian evolution is really unknown to this great naturalist. He seems invariably to strike Lamarck when he aims at Darwin. In this however he is only acting in the same manner as the majority of the early critics of the "Origin." *

In attempting to decide upon the past history of these insects the first necessity is to be sure of the facts. Fortunately the ground has been re-traversed by Mr. and Mrs. Peckham, so that we can compare the observations of great and keen naturalists in two hemispheres. We find that by the study of nine wasps of an American species, *A. urnaria*, of the very genus *Ammophila*, which, as previously described, chiefly furnished the basis of speculation, the American naturalists have shown that the immense superstructure is in large part due to a fertile imagination. So far from the assumed perfection and accuracy with which every detail is supposed to be repeated, the instinct is shown to be excessively variable. The frequently-quoted conclusions that the object of the sting is to reduce the larvæ to helplessness and yet keep it in a fresh condition, that a dead larva would be unsuitable food and an active one a danger to the offspring of the wasp—all these conclusions are entirely disposed of by a few careful specially directed observations. These show that the larva rapidly dies in a large proportion of cases and yet affords excellent food, and that it may remain sufficiently uninjured to wriggle continuously without stimulation, and to move violently when bitten by the larva of the wasp.†

The following activities or performances are regarded as truly instinctive, viz. as due to the compulsion of a hereditary nervous mechanism :—Stinging, the methods of attack, capture and carriage of prey peculiar to each species, the kind of prey selected, the general style and situation of the nest, the form of cocoon.‡

The American naturalists finally conclude their volume with these words :—"The general impression that remains with us

* "Proc. Boston Soc. Nat. Hist.," vol. xxvi, 1894, pp. 377—379. See also Poulton, "Charles Darwin and the Theory of Natural Selection," London, 1896, chapters xix, xx, pp. 144–160.

† *l. c.*, pp. 30, 31.

‡ *l. c.*, p. 234.

as a result of our study of these activities is that their complexity and perfection have been greatly over-estimated. We have found them in all stages of development and are convinced that they have passed through many degrees, from the simple to the complex, by the action of natural selection. Indeed, we find in them beautiful examples of the survival of the fittest."*

As long ago as 1889 the present writer had argued that the Lamarckian interpretation of the instincts of *Ammophila* or *Sphex* introduced the same difficulty as that alluded to in the discussion of the cocoon-making instinct. It implied a gift of prophecy, a knowledge of what would happen to offspring after the burrow had been sealed and left to its fate.†

Another powerful argument is derived from the comparison between the instincts which are performed but once and those which are performed many times in a single life. Various elaborate performances are undertaken but once in an insect's

* See the review of Dr. and Mrs. Peckham's work in "Nature," vol. lix, 1898, pp. 466–468.

† The argument was used in the "Discussion on Acquired Characters" in Section D of the British Association at Newcastle, Friday, September 13, 1889. See Report, p. 620, where, however, only the title of the paper is printed. The following sentences are quoted from the abstract in "Nature," vol. xl, 1889, p. 610 :—

"With regard to instinct, Dr. Romanes had suggested a difficulty—that was, the instinct of certain wasps to sting and paralyze the nerve centres of their prey. But it must be remembered that the benefits arising from this instinct were felt not by the wasps themselves, but by their progeny."

In "Proc. Boston Soc. Nat. Hist.," vol. xxvi, 1894, p. 392, the argument is stated in greater detail as follows :—

"The wasp-like insect has no opportunity of learning by experience because it can never know whether the larva stored up is a failure or a success. If the larva had not been stung, or, accepting the received accounts, had been stung in the wrong place, it would struggle and perhaps kill the young grub ; or dying of starvation it might dry up and be useless as food. But the Hymenopteron never goes back to inquire. It makes all the difference to the young grubs whether the food provided for them is in an appropriate condition or not, but it makes no difference whatever to the parent insect. The latter seals up the chamber in which its eggs have been laid and never opens it again ; it has no chance of noting the failure or the success of the food it has provided. It is clearly a case like that of the cocoon, which cannot be explained on the Lamarckian theory and must be explained on the Darwinian. And this latter interpretation is easy ; those insects which possessed the nervous mechanism impelling them to provide food in an appropriate condition gave to their offspring the opportunity of surviving and inheriting the same instinct ; while others, impelled to perform less efficient actions, were thereby cut off from any representation in the next generation." The passage has been slightly modified.

lifetime, and thus are always "prior to individual experience."* The behaviour which leads to the production of an elaborate cocoon or the burial of a larva in its earthen cell is clearly instinctive, and the most convincing evidence would be required—evidence which it is needless to say is entirely lacking—in order to prove that certain insects which perform an act no more elaborate many times in their lives are guided by anything except the compulsion of a "nervous system built through heredity."† If the cocoon-making instinct has evolved through selection, the comb-making instinct of the social Hymenoptera has surely arisen in the same way and not through the operation of an entirely different set of causes.

As a matter of fact I have witnessed the perfection of comb-building "prior to individual experience" and under conditions which prevented the worker from profiting by the experience of others. I have seen "the worker of a species of *Vespa* freshly emerged from the pupa, and the sole perfect insect upon the young comb (the queen-mother having been previously killed), immediately seize upon the broken material of the comb and begin accurately and with exact precision to build up the thin and delicate sides of injured cells containing the living larvæ." ‡

The strongest of all arguments against Lamarckian evolution was advanced nearly fifty years ago by Darwin in the first edition of the "Origin of Species"; and here too we see that demonstrative evidence was supplied to the greatest of all naturalists by reflection upon the insect world, and of the part of it which we are now considering. "No amount of exercise, or habit, or volition," he says, speaking of ants, "in the utterly sterile members of a community could possibly have affected the structure or instincts of the fertile members, which alone leave descendants. I am surprised that no one has advanced this demonstrative case of neuter insects against the well-known doctrine of Lamarck." §

* For instance, the cocoon-making instinct, already alluded to (see pp. cxx–cxxiii). Weismann has directed particular attention to this argument against a Lamarckian interpretation ("The Evolution Theory," London, 1904, pp. 155 *et seqq.*).

† "Nature," vol. lxv, 1901, p. 51. The passage has been slightly modified.

‡ *l. c.*, p. 50. § "The Origin of Species," London, 1859, p. 242.

It is indeed surprising that Darwin himself, after his own crushing argument against the hypothesis of evolution by inherited experience, should have been willing to admit some tincture of the same principle in other parts of the wide field. If we are perforce thrown upon unaided natural selection for the origin and growth of the most complex and specialized societies of the Hymenoptera, what need have we for co-operating causes of evolution elsewhere?

I conclude this section of my Address dealing with the most remarkable of all nerve-mechanisms of instinct known to us, with the following impressive comparison, made by Professor Lankester, after contemplating the higher forms in which instincts have been replaced by the power of educability. "The character which we describe as 'educability' can be transmitted; it is a congenital character. But the *results* of education can *not* be transmitted. In each generation they have to be acquired afresh. With increased 'educability' they are more readily acquired and a larger variety of them. On the other hand, the nerve-mechanisms of instinct are transmitted, and owe their inferiority as compared with the results of education to the very fact that they are *not* acquired by the individual in relation to his particular needs, but have arisen by selection of congenital variation in a long series of preceding generations."

"To a large extent the two series of brain-mechanisms, the 'instinctive' and the 'individually acquired,' are in opposition to one another. Congenital brain-mechanisms may prevent the education of the brain and the development of new mechanisms specially fitted to the special conditions of life. To the educable animal the less there is of specialized mechanism transmitted by heredity, the better. The loss of instinct is what permits and necessitates the education of the receptive brain."

"We are thus led to the view that it is hardly possible for a theory to be further from the truth than that expressed by George H. Lewes and adopted by George Romanes, namely, that instincts are due to 'lapsed' intelligence. The fact is that there is no community between the mechanisms of instinct and the mechanisms of intelligence, and that the latter are later in the history of the development of the brain than the

former, and can only develop in proportion as the former become feeble and defective." *

The bearing of Insect Warning and Mimetic Colours upon the supposed hereditary transmission of experience by their Vertebrate enemies.—Adaptations which facilitate the education of entomophagous vertebrates are so perfect and so wide-spread in insects that they constitute a large body of indirect evidence in favour of the non-transmission by heredity of the results of experience. Fritz Müller, in his celebrated theory of mimicry, suggested that the object of the likeness between the warning colours of specially-protected species was to reduce the danger from the attacks of young and inexperienced enemies. This is all the more interesting because, as Professor Meldola has pointed out, "in 1879 the question of the non-transmission of acquired characters had not been brought into prominence. It was tacitly assumed in the theory of Bates that a knowledge of edible and inedible types could be transmitted by heredity. It is remarkable that Müller, by virtue of his hypothesis, should have unconsciously challenged this tacit assumption by suggesting that young birds had to learn by experience, and did not derive their knowledge of eatable and distasteful forms by heredity. The whole tendency of Prof. Lloyd Morgan's work of late years has been to confirm the suggestion by actual observation and experiment; and Mr. Finn, also, in summing up this result, states that 'each bird has to separately acquire its experience, and well remembers what it has learned.' Thus the Müllerian theory of 1879 has now been placed on a psychological basis of well-ascertained facts." †

The problem has been attacked from both sides with concordant results. In contemplating the vast scale upon which these aids to memory and education are developed, it is necessary to take into account the pressure of the struggle for existence upon the enemies themselves. "This pressure is chiefly felt by the young, and it is so excessive that comparatively few individuals in the fresh wave sent forth at each breeding season, survive to become mature and experienced. It

* From the Jubilee Volume of the Soc. de Biol. of Paris, 1899. Reprinted in "Nature," vol. lxi, 1900, pp. 624—625.

† "Nature," vol. lx, 1899, p. 57.

follows from this fact that the amount of selective pressure exerted by inexperienced enemies of insects is many times as great as that which is due to the educational period of the mature enemies existing at any moment."* We also realize the fact that insects as food are of far greater importance than might be at first sight supposed; for they supply not only the insectivorous species but those other forms which in turn prey upon them.

Thus, when we bring together the evidence supplied by the study of insects it is seen that it nowhere supports the assumption upon which Lamarckian evolution is founded, the assumption that acquired characters are transmissible by heredity.

Before leaving the Chair at the conclusion of my second year of office I desire warmly to thank the Officers, Members of Council, and Fellows of the Society, who by their kindness have made my task so easy and altogether pleasurable. You will, I know full well, accord the same generous sympathy to my successor, and under his guidance I feel confident that the prosperity of recent years will be continued, I hope in even larger measure.

Before taking leave of the Fellows in my official capacity I desire to direct their attention to two thoughts, both of which I have endeavoured to keep prominently before the Society, thoughts which I trust will continue to inspire our meetings.

First, ever to remember the high significance of the material we study; to realize its priceless value for the elucidation and the solution of problems the most intricate, difficult and important; to feel that this unrivalled opportunity is a serious personal responsibility.

Secondly, always to bear in mind that London is a great deal more than the capital of England, and that the Entomological Society of London can do much to help the work of naturalists all over the world—men in some conditions better off than we are, in other conditions less well provided, with new and inspiring problems at hand calling for study, but

* Proc. Ent. Soc. Lond. 1903, p. lxv. The form of the passage has been slightly modified.

without the stimulus and the continual aid of our vast stores of literature and our easy intercourse with kindred minds. We can do much to help such men, not only by means of our publications but even more by establishing contact with them, by showing them that their work is of value and interest to the naturalists of a distant land. And although I trust and am sure that such encouragement will be offered freely to every naturalist who may approach us, whatever be his nationality, yet the wide extent of the British Empire and the roving spirit of her sons, ensure that it will be our own people in many lands whom we shall chiefly benefit, who will benefit us in turn. And thus we may hope to aid in no small measure the forces that make for sympathy and friendship and true union between men whose communication is thwarted by both time and space. And this happy result will be achieved by and will itself promote the advancement of that branch of learning for which this great Society came into being, grew into strength and beneficence, and awaits I doubt not a yet more glorious future.

XXVI. *Protective Coloration in its relation to Mimicry, Common Warning Colours, and Sexual Selection.* By ABBOTT H. THAYER. Communicated by PROF. EDWARD B. POULTON, M.A., D.Sc., F.R.S.

[Read October 21st, 1903.]

THE following paper records an artist's examination of the principles of butterflies' coloration, and shows how the results tend to restrict the fields heretofore claimed for Mimicry and Common Warning Colours, and to place them on a basis of Concealing Coloration. It contains also several arguments tending to restrict the hypothesis of Sexual Selection.

It does not attack the obvious fact that every possible form of advantageous adaptation must somewhere exist. It is obvious to its writer that there must be unpalatability accompanied by Warning Coloration,—as apparently in the cases of the Hornbills and Wood Hoopoes reported by Mr. Frank Finn, and probably in many Corvidæ, for instance,—and equally plain that there must be Mimicry, both Batesian and Müllerian. Yet every case demands special examination, for the reasons that I shall show herein; and no apparent conspicuousness of coloration is sure to prove such when examined on the principles established in this article.

First, it seems necessary to establish the artist's claim to be *the* judge of all matters of visibility, and the effect, upon the mind, of all patterns, designs, and colours. If even the artist is limited in this, his own field, what hope is there for others? Fullest wisdom on the part of naturalists would make them adjourn all matters of animals' appearance to us artists, just as any wise ruler gathers about him the most highly specialized minds, to widen, through them, his own scope.

An artist reads design wherever it occurs, just as a composer reads a score, without playing it, or hearing it. He perceives that every juxtaposition of spots, or shapes, or colours, or of dark and light, and of degrees of these,

is just so much representation of some structure, whether the representation be accidental or intentional. He sees at a glance in marble-veins, the grain of wood, etc., not *imaginary*, but *actual* representations of natural objects and perspectives, and weighs the correctness of these. Nature has evolved actual Art on the bodies of animals, and only an artist can read it. When he examines the colour and colour-pattern of the animal kingdom, he sees that zoologists are hopelessly off the track in their general conception as to which coloration is to be called conspicuous, *i.e.* rendering its wearer so. *Any* coloration or pattern would be conspicuous *somewhere*, and Nature cannot prevent animals from straying beyond the environments that would most perfectly harmonize with their colour and pattern. But let us take the broadest possible survey, and we cannot doubt that most animals wear on their coats pictures of their habitat. As I before pointed out, even the under-sides of the wings and tails of hawks bear the general twig-patterns so common on forest birds, as if Nature found it worth while to efface the white silhouette their wings' under-sides would make when they extended them while perching. We see how completely such patterns (when couched, of course, as they always are, in the effacive gradation) *do* help to obliterate a partridge, grouse, woodcock, hare, or any other of almost all the species in every order; since they prove to be actual *animated pictures* of their environment. As I said before, in my paper on so-called "Banner-marks,"* these forest-like patterns are found on forest creatures, and not on desert creatures, or ocean creatures. Sand-birds are usually marked in longitudinal, delicate patterns, very like those the sand assumes when seen at the same angle at which one observes the birds themselves. Tigers and zebras are resolved into pictures of tall, strong flags, grasses, and bamboos, while the lion is a picture of the desert. (It will some day be plainly understood that the effacive gradation is the essence of the success of these patterns. Were they not arranged to compose one perfect counter-gradation, from top-dark to under-white, they would appear merely as what artists call "lines of quantity," like the hoops of a barrel, *emphasizing* the rotundity, not effacing it.)

Now, let me prove that *any* pattern would somewhere be

* 'The Auk,' vol. xvii, 1900, p. 108.

conspicuous. I once saw a skunk (*Mephitis americanus*) crossing a snow-field near at hand. This animal is black (with the slight amount of effacive gradation found even in black animals), with a large white pattern on top. He was totally unrecognizable, because his white against the snow was undistinguishable. His black was left to form a most grotesque silhouette. Had he been against black, it would have been this black part that disappeared, and one would have seen only an unrecognizable, moving *white* thing. Naturalists' lack of understanding this principle's immense import has gone far to strengthen the present Mimicry and Warning-Colour theories, which may prove to have been evolved, largely, in the effort to explain supposed conspicuousness, where such did not exist. A tiger in the desert sands, though his gradation would still, more or less, efface his solidity, would nevertheless show his *pattern*. His bamboo-vistas would be plainly a failure against the sand. The lion in the bamboos would, when not covered by them, tend to present an unaccountable *flat silhouette*,—a lion-shaped section of desert-landscape, out of place. On the same principle, a white patch on striped cloth or a striped patch on white cloth would be conspicuous. We see on all hands evidence that Nature cannot help moving forward to the utmost completeness of protective devices;—that, in fact, she cannot grope or blunder. A marvellous, turquoise, emerald-green and red-coral-marked Mediterranean fish looks conspicuous on the fishmonger's slab; but follow him to the sun-lit ocean grottos which he inhabits, and of which he is a wonderful picture! No, the whole use of the word *conspicuous* is mainly born of the zoologist's lacking the artist's sight.

Let us now turn to the field in which the naturalists are most conspicuously at fault, that of the butterflies and moths. One glance of an artist,—that is, of an artist accustomed to lifelong looking at vegetation and butterfly-life,—at a world's collection of butterflies, shows him that they are mainly either flying pictures of various combinations of flowers and their backgrounds, pictures of the *shadow under foliage*, with delicate patterns of vegetation or flowers drawn across it, as, for instance, in the North American *Papilo polydamas*, and the dark *Satyrinæ*,—or that they are wonderful representations of flowers themselves, as in the *Pierinæ* (all but their usually narrow dark

border), many of which even bear a representation of six stamens (counting their two antennæ), and, what is very common in butterflies, a wonderfully perfect shading on that part of the wings next the body, grading toward it in a way that makes it appear like the bottom of a concavity. My photographs of *Limenitis* (*Basilarchia*) *arthemis* show the flower-form, the appearance of the rim of its cup being carried across the butterfly, as in the species of *Precis* which wear a large, bright semicircular bar, cutting them as the skunk's white cuts him.

I should have placed at the beginning this axiom: *Only unshiny, bright monochrome is intrinsically a revealing coloration.* As soon as patterns begin, obliteration of the wearer begins, as shown in the case of the skunk. Nature does not blunder, and Natural Selection would evolve the monochrome, instead of a patterned surface, were simple conspicuousness her aim. Also, she would, if she used patterns mainly as badges for identification of the wearer, have omitted the delicate subtilties that go to make up the patterns of most butterflies. Let us apply the skunk-lesson to the many dark butterflies which wear more or less bright, clean-cut patterns. As they rest on flowers, their *dark* matches very closely the shadow-depths *between* the flowers, especially when seen from above or outside the flower-mass; and, in fact, the delicate general gradation and *faint* detail existing even in these parts, appear to an artist to represent the near vistas under the flowers; while the bright pattern is likely to echo the notes of the flowers themselves. Only artists understand this colour-echoing. The artist's sight is conscious, as it ranges over a scene, of every recurrence of each colour-note. This colour-note, wherever seen, seeks, as it were, *its own*, in his brain,—just as a violin-string rings when its note is sung. In a book we are writing on protective coloration, my son and I shall show larvæ that resemble *things* (already well known), larvæ that disappear, larvæ that appear to be extensions of leaves; and larvæ with many other startling and dissimilar concealment-schemes. What wonder if in butterflies there prove to be as many different forms of concealment? It is impossible to lay too much stress on the fact that all patterns which look so striking and bizarre, when *off* duty, are, when *on* duty, up to the moment of detection, precisely the workers of the magical illusion that conceals. It is inconceivable that birds should

more easily recognize minute patterns than colour, when we realize that the perfect colour-adaptation of innumerable forms of life, from mammals to larvæ, proves *that the lower animals see colour* (since otherwise such adaptation would not be necessary for their concealment). In each form of protective coloration there exist cases so pronounced as to leave no doubt of their use. Each of these has been assumed to be mimicked, or, at least, echoed, for some reason, by other species than the one in which it is most perfect. Let us look at the dead-leaf pattern, *i. e.* the pattern that represents, in the most minute degree, substance of the *colour and thickness of dead leaves,* and lying as near the ground as dead leaves usually lie. This pattern is marvellously perfect on the Copperhead snake (*Trigonocephalus contortrix*), on some Boas, on that form of domestic cat which has the most tiger-cat-like black and grey pattern (as well as, in fact, on tiger-cats themselves), and on several Sphinx moths. Of course, when this leaf-representation occurs on the rotundity of animals' bodies, as in the cats or snakes, it exists only in co-operation with the regular effacive gradation, but on the flat plane of a Sphinx's upper-wing-surface it has and needs no such co-operation. In the Sphinx-moth photograph which I have sent Professor Poulton, this reproduction of thin material casting a shadow on the surface it lies on is past all mistaking. This artifice is present on many moths, and its elements are traceable in such butterfly genera as *Vanessa, Grapta,* and many others. To know at what point in the long series of somewhat similarly marked species the original function has ceased, would require impossible study.

While it is plain that a hundred needs may each be represented in the pattern- and colour-schemes of animals, it is also plain to an artist's eye that in most butterflies all visible details of colour, pattern, and form are essential parts of the representation of flower-scenery. And it is surely conceivable that, in a certain region, one particular form of flower-scenery-representation may furnish such advantages to butterflies as to cause many widely-separated species to become modified till they wear a common aspect; and it is conceivable also that there would be one common form of wing which would best lend itself to this scheme. Surely we do not know enough of the habits of these insects or of the regions that may be their strongholds to

feel sure that this hypothesis is absurd; and were it correct, it would complete a chain of seemingly perfect evidence.

After we see how inexplicable it would be if butterflies did *not* either resemble flowers, or represent some portion of flower-scenery, why should we, in view of the endless variety of flower-forms, stick at any form or pattern in the butterfly that frequents them? One must constantly remember that *any* pattern is less conspicuous than bright, unshiny monochrome. Therefore, "*conspicuous*" is not the right word for the character of patterned butterflies.

Now since the *Ithomiinæ*, *Heliconinæ*, and *Danainæ*, such for instance as the similarly coloured cow-red and chrome-yellow, black-bordered *Melinæa*, *Heliconius*, and *Lycorea* (and equally, in other colour-schemes, all the other so-called mimicking groups), are in every way completely painted by Nature into these three tones,—the note of *shadow under vegetation* making their borders, which it occupies, coalesce with the shadow under the flowers, and disappear, while the red and chrome wonderfully reproduce the colours and patterns of such flowers as *Odontoglossum triumphans*, who shall say that it is not to this flower—which perhaps, by its abundance, dominates the region—that these cow-red and chrome-yellow butterflies owe their common appearance? Some such flower may be overwhelmingly attractive for its honey.

Perhaps the most conclusive of all our evidence is to be seen in the transparent winged members of these mimicry groups. *Dismorphia orise*, for instance, with its green transparencies enclosed in a pattern of the same velvety dark fuscous that I have already described. What conceivable artifice could offer greater opportunity for frequently remaining unnoticed amidst flowers and leaves?

These little green windows must of course allow any bright object to show through them, while the fuscous cuts the aspect to pieces by representing a shadow far below the insect. The very word *transparent* wrecks any theory of conspicuousness or adaptation suitable for a badge. Add to this the present belief that the transparency has been attained through selection, and ought not those who hold this theory to believe that concealment was obviously the goal of a *change toward invisibility?* It is hard to conceive of a better device for representing little green leaves than by these glossy green, leaf-shaped,

and leaf-veined windows, bordered with imitation background, and ever ready to look like glossy leaves the moment they are extended over a bright flower or other bright object.

Professor Poulton has already noticed the efficacy of the imitation hole in the wing of *Grapta* (a device similar in effect to the gold dots on some pupæ).

During the writing of this article I have been learning that iridescence itself is an immense factor of concealment, far greater than I at first realized. I have lately had excellent opportunity to study several species of golden-brown butterflies with sheeny black tips spotted with white, and I begin to realize the wonderful power of this combination. The white dots *stand changeless,* while upon the black, in bright sunlight, faint rainbow sequences dissolve the *actually* flat wing-surface into liquid depths, apparently wholly detached both from the insect and from the white spots, which appear, as I before said, to be shiny points like dewdrops down in the spaces below the butterfly.

If butterflies were mimicking each other, Mr. Blandford's objection (Proceedings of the Entomological Society, 1897) that the resemblances would be hypertelic would seem true. Since an attempt on Nature's part to give common colours and patterns to a group of insects involves no need that any one of them shall have sharp delicate contours of spots, or have subtle gradations, these species would, if their object were to resemble each other in their colour and markings, stop short of such sharp contours, etc. On the other hand, if they are representing flowers or any organic *forms* instead of merely patterns, etc., *on* forms, they would profit by the utmost minute finish of every part of their design, since just this *finish,* this microscopically perfect smoothness and minuteness of detail is an essential characteristic of flowers and even of leaves.

Upon my hypothesis, the many "warning-colour" species that have dull-contoured spots instead of sharp ones, would seem (as they do to the supporters of Mimicry) to be species in process of adaptation, but *to the aspect of flowers,* instead of to that of each other.

As soon as the advocate of the Mimicry theories sees that to wear the region's prevailing pattern *tends to conceal,* his case looks bad; since we see throughout the animal kingdom common coloration, and often common

form in widely separated orders, plainly accompanying common environment and habits. The Salmon's silver, grading upward into dusky, and downward to purest white, is identical with that of countless fish in many groups, and no one doubts that environment and habits are the cause. Among birds, *Emberiza miliaria*, *Anthus pratensis*, *Alauda arvensis*, and *Alauda arborea* are four species of three genera for all four of which *one* minutest colour-and-pattern-description would almost suffice; and the same colour-scheme and pattern with slight variations is found on a great many other species throughout the world, both of *Passeres* and even *Scolopacidæ* and *Gallinæ*, telling plainly of *life on the ground amidst grasses.* Among the *Scolopacidæ*, many females and young of the *Anatidæ*, and the *Laridæ*, Nature betrays, in the main, great lack of variety in design, easily accounted for by the lack of variety in the aspect of the environment. In a broad survey of the animal kingdom we perceive that everywhere the degree of colour-and-pattern difference between different members of an order, family, or genus keeps pace with the degree of variation in their environment's aspect.

Why may not the circumstances of a group of butterflies furnish them similar needs to wear a common livery, even if we cannot see the reason? Might they not tend also to have their *flavour* similarly affected by similar food? The Spruce Grouse (*Canachites canadensis*) is saturated with spruce flavour, and the world is full of such cases. Even the amazing similarity between members of these groups is no proof they may not, for reasons which we have not discovered, profit each by exactly the same form of concealing-coloration. It should be borne in mind that it is not a *flower* that these mimics evidently represent, but a certain combination of the flower's aspect with that of its surroundings. Hence there may be one best way to render this. Butterflies on wing are conspicuous, but are wonderfully protected by their jerky flight, which is completed by their wings being so large as necessarily to throw the body up and down at every movement. This latter advantage, attainable by no other conceivable means, may be a great factor in the whole matter. In flight they are doubtless practically safe, *i. e.* too troublesome a quarry to be seriously decimated. I send, for Professor Poulton to exhibit, photographs of a number

of so-called conspicuous butterflies (dead specimens), the examples having been placed as far as possible without an unfair attempt to favour my argument, except in a few cases where the attempt is obvious. Surely they speak eloquently. Could they be seen in their colour-coalition, they would speak even more so. Any one *carefully* examining them will see that, in most cases, their dark parts are not distinguishable from the background (*although the average person, unaccustomed to analyze his sight, will, by recognizing the butterfly through its pattern, fancy he sees every part*).

The very keynote of the zoologist's error is psychological. One *sees* only what is out of place;—that which is *in place* is harmonious and unnoticed. We know how many of these concealed animals we *see,* but we do not dream of how many we *pass by.*

By tracing back to so palpable an example as our Sphinx-moth photograph, we see that the various combinations of sharp-edged markings with delicate blendings, exactly resembling the combination of patterns made by any sharp-edged fabric lying near a ground on which its shadow falls, do *represent* such combinations of form; so that we must believe that so elaborate and delicately complete a design would scarcely exist merely to identify a species as unpalatable. We find on several *Preces,* as on many *Vanessæ,* and *Papiliones,* very highly developed cases of the varied combinations of design worn by multitudes of the most obviously protected birds, and other animals;—slight variations of representation either of near objects casting a shadow on the background, as in the cats, snakes, and moths mentioned, or of near objects relieved against more distant, fainter ones, as in the European Woodcock's wings, many female Pheasants, and male Pheasants' tails, such as that of the Copper Pheasant. Doubtless each species has some particular headquarters, as it were,—some region which it fits best,—and unless we chance to study it in this very region, and at the most favourable season, we shall never witness the full operation of its protective colour-scheme. Mr. Frank M. Chapman has already pointed this out in a paper entitled "On the Birds of the island of Trinidad," published Feb. 1894, in the "Bulletin of the American Museum of Natural History," a paper containing some very prophetic glances into the future of protective coloration.

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Apparently Nature has two main protective-colour schemes; one of which is closely imitative of the *very near environment* of the animal, and applicable to such species as sit close, and keep still, for concealment, as do the tree-toads, moths, goatsuckers, certain snakes, and, among butterflies, the species of *Grapta*. (The latter, at least, keep very still when resting, and expose at such times only the rock or bark representation on the under-side of their wings.) Among those butterflies, on the other hand, which have no pronounced habit of protecting themselves in this manner, Nature seems to have been forced to a bolder, more positive way by furnishing them an upper-side bearing a sort of conventionalized representation of the predominant details among which they are destined to move. Flowers, of course, must almost always be present. And always the notes of the conventionalization are *perfect*. Here is a most impressive argument, viz., so-called conspicuous butterflies have the body, head and all, exquisitely effacively graded. Would it not be absurd for Nature to spend energy in *effacing* the *body* while making the *wings conspicuous?* The multitude of species, the world over, whose main colour is largely the peculiar fuscous of shadow under vegetation, have in most cases not merely this shadow-colour, which so perfectly coalesces with the shadow and apparently vanishes from the insect, but also a system of exquisitely delicate perspectives *within* the patches of shadow-colour; as in the genus *Caligo* especially. I mean that *Caligo* is an exquisitely developed representation of the perspectives which an artist sees in peering down through the openings between the flowers. The parts of the world which I know well do not yet furnish me a clear vision why so many butterflies, such as several *Preces*, and *Anosia plexippus*, for instance, have these delicate perspectives done in golden brown instead of either shadow-colour or the more delicate flower-colour; but that this delicate design does represent perspective, and would be wasted if used for any attempt at conspicuousness, and that it is entirely akin to the perspectives rendered on perfect shadow-colour in so vast a number of species, is reason enough for trusting it to prove to be some form of concealment device; and on red flowers these species show surprisingly little. I myself suspect that butterflies of the *A. plexippus* type represent half a concave flower. Watch any butterfly of this class, or any

of the classes in which the pattern, when the wings are open, arranges itself in amphitheatre-like semicircles of stripes or dots, etc. When such a butterfly rests with open wings on a flower, its head is at the centre, its antennæ form two stamens, and these semicircles seem to belong to half the flower of which its head is the centre. In several *Preces*, and many other butterflies, there is a general representation of something like a bunch of stamens casting their shadow deep under them in the flower's cavity. Usually a butterfly's upper-side has the exact colour-note characteristic of flowers and flower-scenery seen from right overhead (take, for example, *Papilio turnus*); while its under-side is a picture of such greater distance as would be seen from the *side* position necessary for beholding it when the wings are in their characteristic vertically-folded position; and this is the position from which enemies on neighbouring bushes would see it. So-called "conspicuous" butterflies have, in short, their upper-side designed with the full strength "values" of the nearest flowers looked into from above, and their under surfaces designed in notes more delicate, to counterfeit the distance, and a perfectly effacively-graded body. Their under-side is also more delicately finished, as if against the nearer inspection possible from neighbouring bushes. In fact, they wear every conceivable aspect to fit them into the background from each point of view, and make you think you see through them; or else, seen from above, to make you think, as in the case of the *Pierinæ*, that you see a flower itself. How can such a case call for a theory that is based on the hypothesis that they are conspicuous? One very important fact is that we have abundant proof that animals, including birds, have totally different sight from ours; and the existence of these patterns, etc., unless it can be denied that they even *tend* to efface, should be taken as proof that they sufficiently *succeed in effacing.* Otherwise, why are they there, when almost the whole animal kingdom does need concealment? A fox, a deer, a bear, a grouse, a turkey, or any small bird or mammal, may come almost to one's feet if one stay still, yet flee wildly on seeing any motion. Is not this sufficient proof that even if we were usually able to detect a Papilio when it is effacively situated, it is no sign that a *bird* could do so, if the insect kept its place?

Butterflies very often remain unobserved amidst flowers or other vegetation, by any one approaching (especially if he be not keenly in search of them) until once flushed. Of course our yellow and our white *Pierinæ* are pretty sure to catch the eye of the person approaching, if, as very commonly, they are found amidst dark vegetation. Yet their colours are precisely those of our most abundant flowers, just as they are our most abundant butterflies. This fact harmonizes with my argument that, however conspicuous in many situations, few animals are so in the place or region to which they doubtless owe their abundance. We see largely the overflow individuals *from* a concealing region *into* a less favouring one, and erroneously think of the species as typical of the region where it is visible to us. The gentle waving of the wings, so common among butterflies when they are feeding, seems plainly a protective imitation of the swaying of leaves and flowers in the breeze. Any one who has photographed outdoor vegetation knows how seldom it stands still.

To sum up, the general aspect of each animal's environment, throughout the animal kingdom, is found painted upon his coat, in such a way as to minimize his visibility, by making the beholder think he sees *through* him. How has it chanced that, while this fact has long been recognized, in a crude way, in many fields of zoology, it has remained essentially unnoticed in butterflies? Their most critical moments being passed upon flowers, the aspect of flowers combined in various proportions with the dark vistas down among them to the shadowy earth beneath, is exquisitely painted upon a vast majority of the world's butterflies, and on none more plainly than on those called conspicuous. The *Pierinæ* are mainly representations of flowers, though surrounded by a dark border which appears to belong to the shadows beneath it. On the other hand, there are a vast number of dark species which represent a portion of this shadow-under-vegetation, with bits of yellow vegetation, or of flowers, seen against it (these of course being rendered by the light markings). Could small, bright patterns on dark possibly be more perfect generalizations of small blossoms, buds, and stems?

I cite the following examples of the various colorations described.

Among the *Brassolinæ, Caligo eurylochus* is a marvel of

wholly effacive design, so subtle as to make it absurd to suppose that Nature could be trying to have him conspicuous, or to use such delicate gradations for *identification*. *Caligo telamonius* and *Caligo demosthenes* are even more wonderful examples. *Cynthia* has a wonderful multiplicity of perspectives represented on its surface. Black and green *Nymphalinæ* are notably orchid-like in design. Their dark tips disappear, uniting with the shadows. *Dione* has good near-scenery on its upper-side, while the silver spots of its under-side appear in a side view to cut holes through its wings.

The Danaine butterfly *Limnas chrysippus* is covered with design which I am not prepared to interpret. Whether or not it is a flower, the four interior spots on the upper-side of the hind-wings may pass for stamens, as may also, of course, the antennæ ; and whether or not the yellow-red ground counterfeits the colour of a flower, it represents a flower's form. *Caduga melaneus* has the colour-scheme of the skunk, with, of course, similar advantages.

The *Satyrinæ,* i. e. the dark ones, with strong, light patterns, have also the skunk's colour-principle. The *Danainæ, Ithomiinæ,* and *Heliconinæ* of South America, *Lycorea, Melinæa,* and *Heliconius,* for instance, display marvellous mutual resemblance, yet their likeness to *Odontoglossum triumphans,* when their dark tips are cut out by coalescing with the shadow, is most impressive.

Among the transparent *Satyrinæ* I may mention *Pierella nereis.* Unmistakably the whole surface of this insect (and likewise that of *Cithærias menander*) pictures a single flower.

Pierella astyoche represents flower-scenery (likewise *Pierella rhea*).

In the Oriental Danaine genus *Euplœa* we see exquisite shadow-perspective over which white spots relieve. The blue sheen, seldom or never occurring on both wings at once, additionally effaces.

In the *Lycænidæ* the exquisite *blue* species represent flower-cups, their black border of course detaching into the background.

The above examples I have chosen from all the families I have lately examined, which do not include the Skippers, or the great mass of *Papilionidæ.*

Let me add a few more reflections, all harmonious with my theory.

The act of flight tends to obliterate pattern, by the too quick substitution of one colour for another before the eye. A black-and-white butterfly, therefore, tends to look simply *grey* in flight.

It is not necessary to conceive that a bird must find the imitation flower on its proper plant, if the flower represent a type common in the neighbourhood. A vast majority of butterflies, including most members of Mimicry groups, have the common dark wing-tips of the *fuscous* colour which causes this portion to seem lacking from the butterfly, leaving the lighter-coloured parts to represent a more flower-like form. The white dots, so common on these black tips, surprisingly aid the representation of *space below the flower* by supplying the average sharp details that are to be seen down in the shady under-spaces,—little glints of light on twigs, etc.,—and their dark ground is rendered additionally transparent in appearance by iridescence.

If the foregoing arguments prove that the so-called Warning-colours commonly cited do not exist mainly to make their wearer conspicuous, it does not follow that they may not still serve *secondarily* as Warning-colours. When, for instance, they happen to fail to conceal, they may then serve to warn. My main point is that they first of all *conceal.* I suspect that the same principles apply to striped wasps and hornets, and many other insects called conspicuous. The yellow pattern unmistakably allies their appearance to the pollen-covered flower-interiors, making them far less conspicuous than an unmixed need to be seen would have them. Yet when seen, they may well profit by the pattern's recognizability.

Can any one, once shown, as I here show, that butterflies' patterns are *not* intrinsically the thing to make the wearer conspicuous, and shown that they *are* wonderful representations of the flower-scenery I describe, believe that Natural Selection has bungled, and *wasted* design of the most intricate kind? No, it is the beauty of the whole thing that *absolute fitness* is the goal of all changes by Natural Selection:—is, in fact, the only motive-power; changing all forms steadily toward itself.

We see, then, that butterflies are imitation flowers, or pictures of flower and background. This has escaped the eye of zoologists. They see that fish wear representations of under-water scenery; that forest animals are forest-

patterned; beach animals, beach-patterned, etc., through the whole animal kingdom. But this other obvious case has escaped them. What other equal hope were there for insects that feed in full sunlight on masses of bright flowers?

In another paper I shall extend this criticism on the animal-conspicuousness-theory to the field of birds, and to strengthen the present paper by showing reasons to suspect that this theory is also not well intrenched in the bird part of its field, I append the following examples of the material to be used in the next paper.

Several of the most apparently conspicuous details of the exteriors of male birds can be shown to be such as would aid them to escape their enemies, and it is plain that simple life-preservation must for ever take precedence in the scale of importance of animals' needs. It is a mild statement to say that if the animal kingdom is to survive, females have greater need of the mere *existence* of mates than of any particular attribute in them, and if this statement is true, in all its immense import, it is among the most primitive needs of the male, that we should search for the explanation of his present attributes. All the nuptial developments, either of feathers or fleshy growths on beaks, etc., are much more rationally explicable along the simple lines of utility, than those of direct Sexual Selection, since it is apparent that every appendage, and every brilliancy of colour or costume adds to the formidableness of a warrior's aspect. One male conquers another partly through overawing him by superior splendour, and actually looking larger by means of his appendages, and when these gaudy-feathered braves flaunt before their females, why are they not presumably appealing to the females' love of a good fighter,—a sentiment so dominant, even in the human race,—and a simple sense of what constitutes a husband full-equipped for the rough work devolving on all feudal lords? In fact, from which end of the animal scale is this human sentiment traceable? If from the lower, as seems obvious, it must exist there. I believe that a material need for any existing thing will always be found to precede the spiritual, just as simply as a man must *catch* before he can *eat*, and will *then think*.

These arguments suggest, at least, that the nuptial superficial developments are for the direct use of the male who wears them. Let us look at the iridescent splendours

of the Peacock family. An artist can see that whereas unshiny monochrome reveals its wearer to the utmost, iridescence, on the other hand, destroys visibility of surface, by substituting for a normal light-and-shade gradation, a totally new succession of colour and light notes, and above all one that changes its character with every movement of the bird, and every change of the beholder's standpoint. Add to this in the Peacock's case, for instance, his habitual resort to dense cover, and his gorgeous blue and green gleams, through its interstices, present merely the aspect of foliage-colours and hints of flower-masses. I feel sure that Peacock hunters will testify that this bird is hard to see when lying close.

Let us imagine an animal stalking this bird. He will look *wholly for motion*:—(such at least is the habit of all predatory creatures I know). Now it is the peculiar property of sheen, that it will *stand still* while the thing it is on *moves*. This means that a Peacock can move his brilliant neck, while its sheen *stands still*,—just as the gleam on the telegraph wires keeps pace with the railway train as one sees it from the window. And since this gleam of the bird's neck must be the most visible thing, the possibility of the neck's gliding along *behind* it, while *it stands still*, must often save the Peacock; (for the balance between the *evolved skill of the hunter* and the *evolved skill of the hunted* must always be close, and smallest advantages must often tip the scale). While the fore-part of the bird is beginning to move, unnoticed, his conspicuous tail, a yard behind his vital parts, catches the tiger's eye, in its earliest motion, and the tiger, seeing no other part so distinctly, springs at these long feathers, whose design is arranged for *conspicuousness in motion*.

These gorgeous birds will prove to be additionally concealed, not revealed, by their costumes. It is worth mentioning here, in connection with the Warning-Colour theory, that while Peacocks and Pheasants are *iridescent plumaged* birds, and would be called conspicuous in the highest degree, they are not *unpalatable*;—a fact that goes to strengthen my argument.

The next thing to be pointed out is that the general tendency of birds to wear longitudinal markings forward, and transverse ones aft, is an important factor of protection, especially in the case of the Pheasants and Peacocks, among whom this arrangement is very highly developed.

Any one who has tried to catch a snake in the grass will see at a glance why Nature tries to direct an enemy's attention behind the animal he is hunting. The snake for ever proves to be further on. It is hard to set one's foot far enough ahead as he moves, just as a wing-shot tends to shoot behind. Now Nature, realizing this, offers the enemy the utmost inducement to strike too far back. The strong cross-bars of the Reeves or the Copper Pheasant, while visually they cut the tail to pieces when it is still, are, as with the Peacock, by far the most visible part of the bird as soon as he moves. The reason of this is that in forward motion the longitudinal markings scarcely show, while the transverse ones become conspicuous. To prove this, any reader has only to blacken a few points an inch or so apart on a white cord, and then move the cord longitudinally, drawn tight across some aperture a few yards away, the cord being only visible where it crosses the aperture. He will see that its motion is distinguishable much farther off when the spots are in sight than when the *unmarked* cord is passing. The spots correspond to the tail-marks of the Pheasant, and the cord where it is *not* spotted represents the bird's longitudinal markings, *i. e.* his body-markings.

Before closing I beg to say that I do not mean that I am convinced that Mimicry and Common Warning Colours have no hand in these resemblances. I merely point out that the coloration of every individual of the "mimicking groups" of butterflies seems to be the best conceivable for effacing the aspect of its wearer, and also that it is perfectly conceivable that an external influence, like superabundance of certain very sweet flowers, could do the whole thing.

XXVII. *A brief discussion of A. H. Thayer's suggestions as to the meaning of colour and pattern in insect bionomics.* By PROFESSOR EDWARD B. POULTON, M.A., D.Sc., F.R.S., etc.

[Read October 21st, 1903.]

THE discoverer of the meaning of the white under-sides of animals is entitled to a respectful hearing on any question of animal coloration. Furthermore, by his discovery, he has *proved* the benefits which the artist can confer on the naturalist, benefits which we naturalists are only too pleased to receive with gratitude. Our only difficulty is that so few artists seem disposed to consider our problems seriously. In order to be able to do so they must become, at least in spirit, naturalists as well as artists. The more numerous the men of creative power who can occupy, as Mr. Thayer does, the double standpoint, the better it will be for both domains. I therefore express my cordial agreement with Mr. Thayer's claim for the artist. I now propose to make a few comments upon the details of his interesting paper.

Every naturalist will agree that "any coloration or pattern would be conspicuous somewhere." We have often called attention to the fact that colour, pattern, shape, and attitude can only be understood in the natural environment. In fact, Mr. Thayer's own suggestions are, I think, most open to criticism when he is speaking of animals in countries he has not visited; when, for instance, he suggests the kind of concealment brought about by the stripes of the zebra. The lion is the zebra's great enemy, and in spite of their very different kind of colouring they are both adapted to the same general environment. The proportion of dark and light stripes, Francis Galton told us long ago, "is such as exactly to match the pale tint which arid ground possesses when seen by moonlight." So too the suggestion that the groups of similar South American butterflies have gained their resemblance by a common (syncryptic) likeness to some flower which they chiefly frequent would be more plausible if Mr. Thayer had studied them in their native haunts. I have asked Mr.

W. J. Kaye if he can remember the colour of the flowers visited by the black, cow-red, and yellow *Melinæa* group and its mimics in British Guiana, and he tells me they are either white or cream-coloured. Furthermore, Mr. Thayer treats this group as though it were uniform throughout tropical South America, disregarding the extraordinary changes of colour and pattern undergone by its representative species as we pass from one part of the Neotropical region to another. It is almost inconceivable that the following features, which are characteristic of whole groups in particular areas, can be due to the special flowers of those areas. The barred form of Central America, Colombia, and Venezuela, the black hind-wing of the Guianas, the bright yellow band of Eastern Brazil, the chestnut ground-colour of Ega on the Amazon, the black marked fulvous of the Napo River, passing on into the black forms with fulvous marks which constitute so large and characteristic a group in Ecuador, Peru, and Bolivia. In all these cases, nothing short of actual evidence on the spot can warrant the improbable suggestion that we are dealing with syncryptic groups, changing as the species of flowers are replaced by others in passing from one district to another.

Moreover, the theory of a syncryptic resemblance to flowers fails to account for certain broad characteristics of the groups in question, which on the other hand receive a ready explanation on the theory of common warning (synaposematic) coloration. These are (1) the predominance of forms belonging to the sub-families *Ithomiinæ*, with the allied *Danainæ*, and *Heliconinæ*, with the allied *Acræinæ:* (2) the fact that the predominant members of the chief groups in all the other tropical parts of the world are also contributed by the *Danainæ* and *Acræinæ:* (3) the flaunting flight, exposure at rest, and general want of alertness exhibited by the species of these sub-families as compared with others: (4) the more or less exact similarity of the pattern on the under to that on the upper surface, an arrangement comparatively rare in other Rhopalocera: (5) the experimental evidence of the unpalatability of these very sub-families to a large number of the enemies of insects.

Hence, until positive evidence is obtained on the spot in favour of Mr. Thayer's suggestion of syncryptic resemblance, I must regard such an interpretation as highly

improbable, in the case of the groups hitherto explained by the Müllerian or Batesian theories. Of course close syncryptic resemblances between bark-like moths, lichen-like moths, grass-like and pine-needle-like larvæ, etc., have been known and admitted for many years.

Leaving the tropics we find a beautiful example of mimicry, Batesian, or more probably Müllerian, which has arisen in Mr. Thayer's own region, and has never wandered much beyond it, an example moreover very well known to the American artist-naturalist, viz. the resemblance of the northern *Limenitis* (*Basilarchia*) *archippus* (*misippus*) to the Danaine intruder from the tropical south, *Anosia plexippus.*

In this case there is little doubt that the Nymphaline has been actually drawn away from an ancestral appearance, much like that now borne by *L. arthemis*, explained by Mr. Thayer as promoting concealment by likeness to flower-masses and their background. If therefore Mr. Thayer is compelled to admit all this effect produced by the Danaine intruder in his own northern region, why should he not be ready to accept far more extended effects of the same kind in the crowded luxuriant life of the tropics?

I do not think that naturalists *have* so entirely misunderstood the principle of a cryptic pattern resembling some object in the environment combined with the effacive gradation so admirably explained by Mr. Thayer. His illustrations of tiger, lion, brilliantly-coloured fish, appearance of forest and shore birds, etc., all these are accepted at once and have been accepted for a long time. But naturalists have regarded the skunk as conspicuous, and I feel sure that Mr. Thayer will admit that it falls into another category from that which includes the forms just named. If concealment is brought about by the beautiful and delicately adjusted effacive gradation from upper dark to under white, as is now generally admitted, surely the "slight amount of effacive gradation" of the black skunk cannot be the same thing, or belong to the same class.

We must admit Mr. Thayer's main conclusion, that the forms we call conspicuous might be more conspicuous, and also accept the statement that a pattern is less conspicuous than the monochrome.

Admitting all Mr. Thayer says, at least of the butterflies

he knows in the living state, and of the skunk, he cannot contend, I think, that his criticisms are powerful enough to transfer these examples into the bionomic group which contains the well-known examples of cryptic colouring—the skunk into the same category as the hare or ptarmigan, the under-side colouring of the Danaine butterflies, or the Nymphaline genus *Limenitis* (*Basilarchia*) into the same category with that of *Grapta* or *Kallima*, etc. I believe the whole of his criticism of warning colours can be accepted, and can be reconciled with the existing hypotheses. All animals with warning colours have enemies, all are liable to special attacks, in times of exceptional hunger, by enemies which would at other times neglect them. Even the skunk has special bird enemies. Provided such forms are easily seen and avoided by enemies which respect their special modes of defence, it is clearly an advantage to be as far as possible concealed from those which do not respect them. Hence conspicuousness, but, as Mr. Thayer tells us, something very far short of ideal conspicuousness. The black and white pattern of the skunk is probably glaring and conspicuous enough to all enemies near at hand, but at the immense distance covered by the long-range sight of a predaceous bird it may melt into an inconspicuous grey.

The same kind of interpretation probably holds for a cryptic element whenever it exists in the appearance of butterflies belonging to distasteful sub-families. It is the probable meaning of the transparency so widespread in the *Ithomiinæ*, although I do not think it is so effective in concealing as Mr. Thayer supposes. We must remember that many of these transparent species are excessively abundant, flying in clouds often made up of the individuals of several species and different genera. I quite recognize that the transparency may protect such forms against distant enemies, but I should be much surprised if the species of *Methona* and *Thyridia*, as well as *Dismorphia orise*, of which they are the models, are not rendered extremely conspicuous to enemies close at hand, by their numbers, habits of flight, and attitudes of rest. As Mr. Thayer has said, the black and white markings will melt into an elusive grey on a rapidly vibrating wing; but the specially protected groups have developed a sailing flight which shows off the elements of pattern to perfection. When the body in such groups is effacively graded the

explanation may well be that it is advantageous to direct attention to the wings rather than the vital parts; but it is precisely in these groups that the black body, and sometimes the head, are so often marked with white or red. A bright red or orange collar is found in several species. Furthermore, it must be remembered that the body being moved much less rapidly than the wings during flight is more easily seen. The black and white apical area of the fore-wing may help to conceal, as Mr. Thayer supposes, under certain conditions, but the numerous examples of injuries at this very spot, figured in Plates IX and XI of our Transactions for last year, strongly support the hypothesis that it is directive, and diverts the stroke of the attacking enemy from the body.

Apart from the suggested interpretation of mimetic resemblance, which I believe to be untenable, Mr. Thayer's suggestions supplement and complete rather than oppose existing hypotheses. The words he uses of the wasp may in fact be employed of the skunk, and the well-known distasteful Rhopalocerous groups, etc. The colours may not be conspicuous to enemies at a great distance, "yet when seen they may well profit by the pattern's recognizability." We have rather insisted on this latter fact and its advantage, and Mr. Thayer has done us good service in calling attention to the other aspect of the appearance.

Ideas not dissimilar to those of Mr. Thayer's upon warning colours have for some time crossed my mind. Thus last year I suggested as regards the abundant, much-mimicked *Limnas chrysippus*, that its desert form *dorippus* (*klugii*) "is a development in a procryptic direction in areas where the struggle" is especially severe (Trans. Ent. Soc. Lond., 1902, p. 475).

Furthermore, the idea has often forced itself upon me that the ground colour of the type form of this butterfly, as well as of the Ethiopian *Acræinæ* and Lycid beetles, may, under certain conditions and at a certain distance, become procryptic against the prevalent reddish tinge of the soil of Africa.

The author's suggestions of the resemblance of butterfly patterns in general to flower-masses and the shadow-depths between them; of the under-sides of *Grapta* and the upper-sides of many moths representing dead leaves lying on the ground and casting such shadows as they would throw at their small distance from it; of the concealing

effect of iridescence; of the overflow of individuals from a concealing region into one less favourable—in all these we have illuminating ideas which demand the fullest and most respectful consideration. That they are sound principles must, I think, be admitted at once; but their relative importance, the amount of ground which they cover, cannot be decided offhand. I would only point out the extraordinary frequency with which a continuous black colouring unrelieved by pattern is accompanied by iridescence or surface colours of some kind. In view of the whole drift of Mr. Thayer's interesting and most suggestive paper it becomes probable that dead black would be *too* conspicuous even to many a well-armed aculeate or nauseous *Euploea*, and that it is therefore modified so that it obtrudes less upon the distant view of enemies which "mean business."

Although I have criticized some of the details of Mr. Thayer's paper, I should wish again to point out that they concern just those species which have not come under his own eyes in the living state. Naturalists owe him a large debt for the many new points of view and illuminating suggestions contained in his memoir.

XXVI. *Some breeding experiments on* Catopsilia pyranthe *and notes on the migration of Butterflies in Ceylon*, by Major NEVILLE MANDERS, R.A.M.C., F.Z.S., F.E.S.

[Read May 4th, 1904.]

PLATES XXXIV AND XXXV.

THE following experiments were preliminary to a more thorough investigation.

I had hoped to have ascertained with exactitude the amount of heat, cold and moisture necessary to produce the various forms in which this insect occurs. The experiments were merely preliminary in order to ascertain the difficulties and the apparatus required to carry out a thorough investigation. They may be of interest because, as far as I know, they are the first experiments made with icing the pupæ of a tropical butterfly. Even these preliminary experiments are far from being complete, as I was ordered home when in the middle of them and had to hand over my notes and material to another entomologist, Mr. Oswin Wickwar, who did what he could in the intervals of a busy official life.

Catopsilia pyranthe occurs in Ceylon under many different forms, three of which besides *Pyranthe* have received names, namely, *Ilea*, *Chryseis* and *Gnoma*. *Gnoma* is usually called the dry-season form and *Chryseis* the wet, and though *Gnoma* is certainly more common in the dry, it is by no means confined to the dry months, neither is *Chryseis* confined to the wet. It may be said that all the forms occur indiscriminately all the year round, and my first object was to ascertain which was the dry form and which the wet, and what would be the several effects of heat, moisture, etc. on the larvæ and pupæ. The first thing was to ascertain the proportion of each variety, and this I left in Mr. Wickwar's hands, and in the month of February 1903, during a migratory flight, he captured sixty specimens, the weather at the time being very dry and hot.

He mentions (and I will allude to this later) that 75 per cent. were males, and 64 per cent. of the total were

marked like Nos. 4, 11 in Plate XXXIV, i. e. *Gnoma*; the striæ in most, however, not being quite so pronounced as in No. 4.

Only four (all females) bore at all heavy markings as in No. 7 (this I should call *C. gnoma*), and in these the coloration of the striæ was of a light yellowish shade, which shade, he says, appears to prevail in the majority of dry-weather females. These sixty insects would appear to be all *C. gnoma.* I have written to ask him to capture this year several hundreds if possible, as I think the numbers too few for a correct estimate.

A large number of larvæ were kept in a glass jar and the atmosphere was kept saturated with moisture, the temperature being about 80° F.; this was also the temperature of the outside air at the time. A considerable number of the pupæ promptly rotted, and the amount of moisture was necessarily reduced. The left-hand series in the photograph shows the result; they all emerged between the 5th and 12th of December and are mostly females. In future experiments I should employ wet and dry bulb thermometers. These five were the only ones that survived.

A considerable number of pupæ, the larvæ of which were reared under normal conditions, were kept at a temperature between 55° F. and 65° F. by means of ice; the result is shown in the second row of the photograph. All emerged between the 9th and 17th of December. The mean temperature of Colombo is 75° F. and the lowest ever recorded is 68° F., the pupæ were therefore 10° to 20° below normal. It was distinctly difficult to keep the pupæ down even to this temperature, but in future, now that there is a cold storage depôt in Colombo, I would try and make use of it for experimental purposes.

The attempt to keep pupæ in an abnormally hot dry atmosphere failed—the pupæ all dried up.

Finally, certain unfortunate larvæ were in an anhydrous atmosphere, a large glass jar with coral unslaked lime. It was exceedingly difficult to keep them alive, as they, the food-plant, and even the eggs shrivelled up. However, by reducing the amount of lime five specimens survived and are shown in column 3; they hatched between 11th and 13th December.

A wet and dry bulb thermometer would be usefully employed in this experiment also.

The results of these experiments are very meagre, only about fifteen to twenty specimens coming to maturity out of quite 200 larvæ. It shows that the constitution of the larvæ is somewhat delicate.*

I mentioned above that Mr. Wickwar had found that 75 per cent. of the insects captured during the dry February flight were males, and quite independently we had observed that the wet-season flight in November and December were almost all females. I cannot account for this further than to say that possibly during the dry months, owing to a more scanty and drier foliage, the female larvæ, if I may use the expression, succumbed; whereas with the damper and more luscious foliage of the wet months they had no difficulty in surviving. The mystery of these migrations may be explained to some extent by this preponderance of the sexes during the different flights.

By a coincidence a migratory flight of butterflies was in full swing on the day I landed in Ceylon, October 25, 1895, and I certainly thought that I had stepped into a land of butterflies. The harbour, streets, and large promenade, the Galle Face by the sea-shore, was alive with butterflies, and being mostly composed of *Catopsilias*, looked for all the world like a snow-storm. In order to gain some idea of their numbers, I selected two points, one at the edge of the sea and the other twenty yards from it, and then counted them as they flew past. The result of my calculation and that of my companion taken separately gave fourteen thousand insects between 10 a.m. and 2 p.m. The flight usually lasts about a week; we have therefore ninety-eight thousand butterflies passing through a space sixty feet broad in twenty-eight hours. In round numbers 100,000.

The sketch map of Ceylon (Plate XXXV) gives the course of these migrations which I have personally observed during the time I was in the island.

There is a distinct difference in procedure between a migratory swarm of butterflies and a swarm of locusts. I mean that the latter advance like a human army so many miles a day from one point to another, and the

* The larvæ were collected in my garden in Colombo, *i. e.* at sea-level; and all, or the very great majority, in the same week; and all from the same food-plants. A considerable number of the eggs were laid by the same female. I used to follow her when she was ovipositing, and snipped off the leaf on which the egg was laid.

country immediately in front of them is clear of them for the time being; whereas in the former, the butterflies in whatever part of the island they happen to be hatched immediately begin to migrate, so that on the same day the migration is as vigorous in one part of the island as in another. As the butterflies hatch in Colombo they immediately fly north, and their places are promptly filled by the insects coming up from Galle, the Galle ones by those from Hambantotte and so on round to Trincomalee, beyond which in the uninhabited country to the north I have been unable to trace them. The proof that the insects on the Trincomalee side really do follow the coast-line and come to Colombo is shown by the fact that it is only during the flights that certain butterflies otherwise confined to that portion of the island, *Papilio Jason* for instance, occur at Colombo, and are there seen migrating in the same frantic haste as their companions.

On one occasion, on December 2, *i. e.* in the wet season, I was observing the flight from Fort Frederick, Trincomalee. The butterflies came from the northern shore straight across the sea to the end of the peninsula on which Fort Frederick is built; several bushes of the food-plant of *C. pyranthe* were growing there, and these were literally covered with eggs, as many as half-a-dozen on a single leaf; the bushes were so speckled with the multitude of eggs that they looked as if handfuls of sago had been scattered over them. The flights in November and December on both sides of the island undoubtedly comprise a majority of females, but scarcely a single larva out of this multitude of eggs could possibly have come to maturity; there was not enough food for half of them, and on a previous migration the bushes not far off were completely stripped by the larvæ.

The insects composing the coast flight are almost entirely *Catopsilias*, two species of *Appias*, *Euplœa asela*, and *E. montana*, in the hill districts, and *Danais septentrionis* irregularly. I should have mentioned that the process of laying eggs was totally contrary to what one usually observes—there was no attempt to choose a suitable leaf, no deliberation displayed about the operation at all, but every female seemed possessed with the one insane idea of getting rid of her eggs with the utmost expedition, utterly regardless of the fate of the future larvæ, and then madly continuing her flight. When in full migration

they fly with great rapidity, and can give points to *Colias edusa*. They select the sea-coast, I feel sure, simply to avoid obstacles. The road between Trincomalee and Kandy, which runs through dense forest, is also largely used by the migrating insects. When travelling south they have the N.E. monsoon behind them, but when turning north they meet a stiff wind which really seems to drive them to a faster flight. The breadth of the flight is usually not more than a quarter of a mile.

The cross-barred line on the map shows one of the lines of migration of the two species of *Appias*, *Paulina* and *Albina*. They both breed in the low country, as shown by the square dots, and fly in a broad belt of insects about a quarter of a mile wide across the open downs at D'lawa, 4,000 feet, and up to the Horton Plains, 7,000 feet, when they turn north toward N'Eliya, 6,000 feet, cross the plateau towards Rambodde Pass at its northern end, and then make their way again to the low country somwhere near Kandy. Part of the flight edges away across the D'lawa Downs northwards and reaches the N'Eliya plateau through the Hakgala Pass.

The migration of *Euplœa montana* starts somewhere in the neighbourhood of the Hortons, and follows much the same course, so far as I know, as *Appias*.

The uninterrupted line is a curious and interesting one; it is that of *Kallima philarchus*, which annually migrates, sometimes in large numbers, though it is usually considered a rare insect. So far as I can at present ascertain there is only one migration annually in November or early in December. The insects come up from the low country to Haldumulle, then up the passes leading to the Hortons, and then across the plains to some uncertain locality, but where I have no idea. The insect does not occur in the Colombo or immediate Kandy districts nor about N'Eliya.

It is extremely difficult to obtain assistance in carrying out an investigation such as this requires. Entomologists are few in number, and, with the exception of Trincomalee and one or two other places, Europeans are confined to Colombo and the Hill district. The remainder of the island is mostly covered with jungle, is thinly inhabited with only here and there a few overworked Government officials and ignorant natives.

The reason for these flights is at present very obscure; it was probably originally a question of food-supply. This

instinct might have arisen from the necessity for constantly seeking new feeding-grounds for the larvæ. As the species increased this tendency to expand would not only preserve the species, but would cause in time its very material increase; the necessity for constantly enlarging the feeding-grounds would in time produce an inherited tendency to migrate. But in due course, when all available feeding-grounds were occupied, as they soon would be in a small island like Ceylon, some check would be required to keep the enormous number of resulting butterflies within due bounds, otherwise the species would be in danger of annihilation from their very numbers. This appears to me to be effected in the following manner: the insects of the wet-season migration are mostly composed of females, and provided that the males can successfully impregnate more than one female, the result would be an enormous number of eggs laid, and this I have shown to be the case. The migratory instinct is so strong that the females are precluded from taking any precautions for their future offspring, as the females of most butterflies do; and the result is that the struggle for existence among the multitude of larvæ subsisting on the food-plant, which is quickly diminishing by their voracity, and also slowly by the heat and dry weather, is so great that the larvæ which would produce female butterflies succumb, and a great majority of males are produced which form the dry-weather flights. This majority of males would also be another factor in checking the increase of the species. During the intervening portion of the year the species would gradually increase, until the wet months at the fall of the year favour a luxuriant vegetation, and all the female larvæ then survive, and possibly being stronger, crowd out the male larvæ. These larvæ produce the overwhelming proportion of females in the next wet-season flight, with the result shown above. This migratory instinct, originally due to a necessity for the increase of the species, is now become a means of preventing its undue propagation.

Explanation of Plate XXXIV.

Under-sides of bred specimens of *Catopsilia pyranthe*, Linn.

Nos. 4, 5, 8 are males; the rest females.

The first vertical row (Nos. 2, 1, 7, 6) were kept as larvæ in an atmosphere saturated with moisture.

The second vertical row (Nos. 17, 15, 16, 3, 4) were kept under normal conditions as larvæ, and iced as pupæ.

The third vertical row (Nos. 14, 9, 5, 11, 8) were kept as larvæ in an atmosphere rendered anhydrous by unslaked lime.

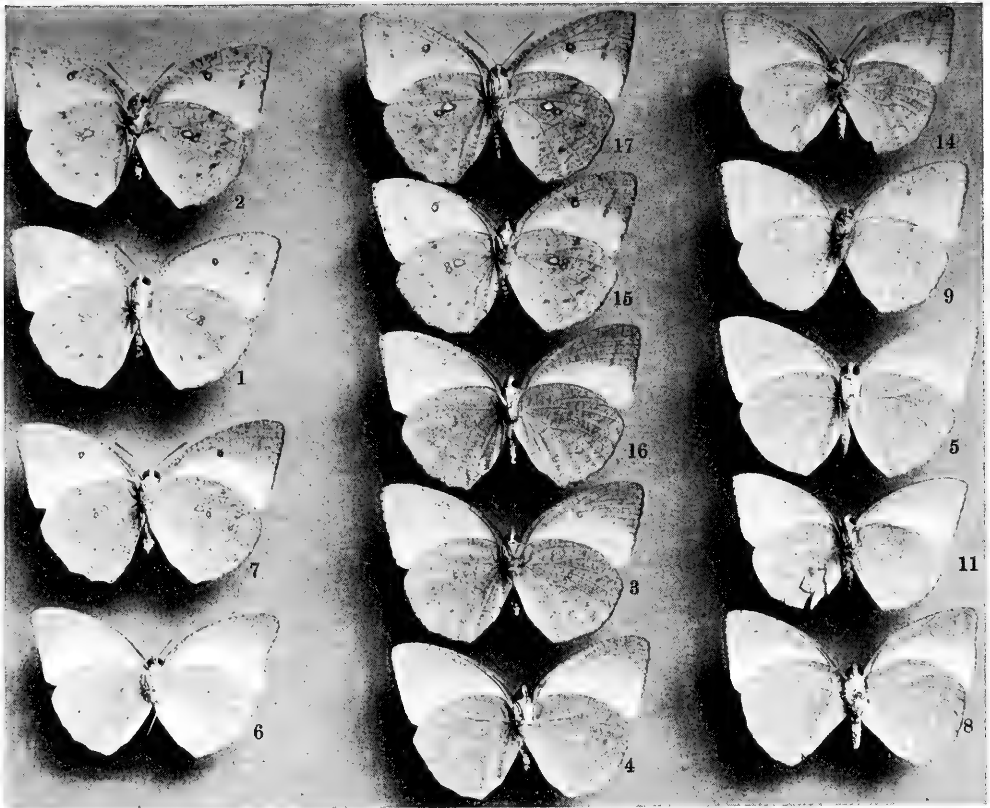
In each row the most heavily marked specimens are placed first; the least heavily marked are placed last.

The first two rows tend to be of the form usually called *gnoma*; the last row consists of the form *pyranthe*.

Explanation of Plate XXXV.

Sketch Map of Ceylon, showing the migratory flight of various species of Butterflies.

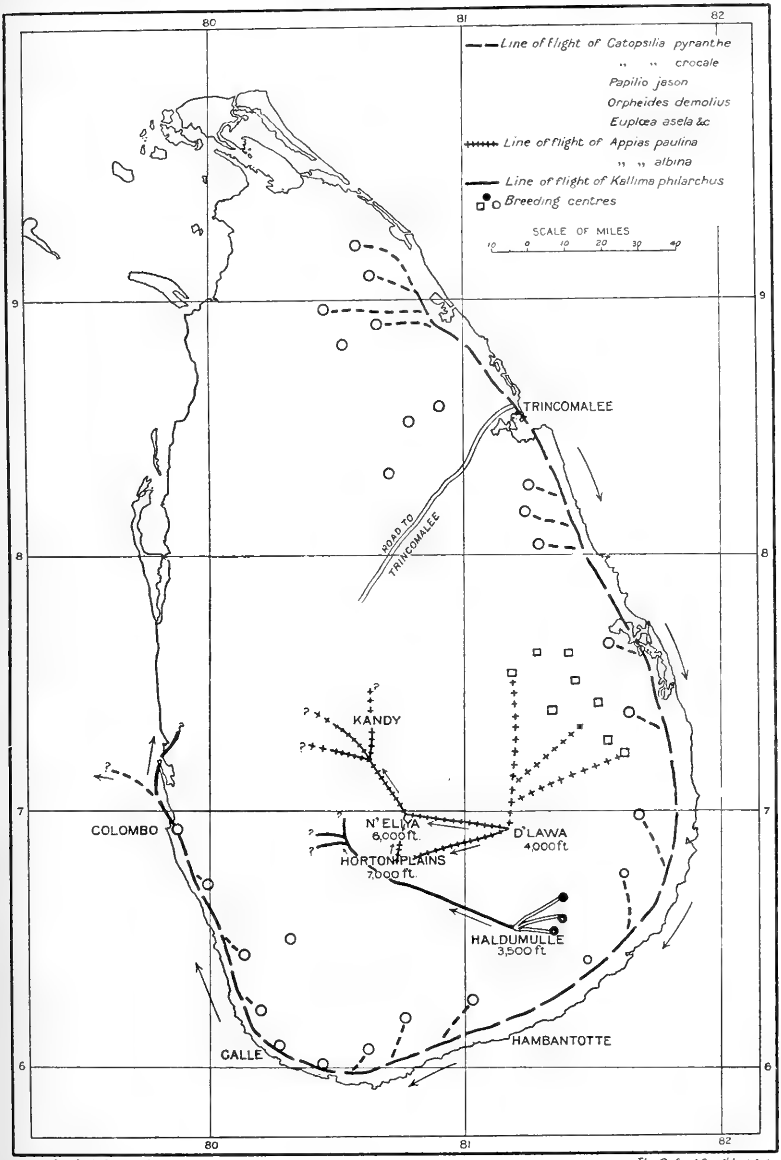
An explanation of the lines employed is given on the Map.



Alfred Robinson, photo. *Andre & Sleigh, Ltd.*

All the figures are about ⅔ of the natural size.

Experiments in breeding *Catopsilia pyranthe,* Linn.



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MIGRATION OF BUTTERFLIES IN CEYLON.

VI. *Notes on the Butterflies observed in a tour through India and Ceylon*, 1903–4. By G. B. LONGSTAFF, M.D., Oxon.

[Read December 7th, 1904.]

INTRODUCTORY.

WHAT follows is an account of the entomological experiences of a "globe-trotter," that is, of a traveller whose main object was to take an all too rapid glance at the scenery, the peoples, and the architecture of the places visited, and whose route was planned with that object. That I was able to give so much time to collecting was due to the fact that, whereas my daughter and her companion felt the heat so much that they usually kept within doors from about 10 a.m. to 3 p.m., I, for my part, protected by a "sola tope" of the "pigsticker" type, and a spinal pad to my coat, suffered no serious inconvenience from the sun's rays *so long as I took active exercise.*

I sailed from England in September 1903 without the slightest intention of collecting, and started accordingly with no entomological outfit save half-a-dozen pill-boxes. Not only was I without net and killing-bottle, I was without books, and worse still, was in woeful ignorance of the Rhopalocera of the Oriental Region.

The day after landing we took train for Simla, and a little south of Jhansi I was struck by the large numbers of bright yellow butterflies along the railway banks—in all probability *Terias hecabe*, L. October 5th found us at Kálka, at the foot of "The Hills." Fortunately the new railway was not yet open, so we had to be driven up the 58 miles to Simla in a "tonga," or post-cart, by a wild-looking hillman who handled the ponies magnificently. To one fresh from Europe the sights on the road were truly marvellous: long trains of wagons drawn by humped oxen or by buffaloes; natives in divers strange costumes, or lack of costume; flocks of goats and herds of cattle; strings of pack-mules, and, to crown all, long lines of solemn camels, always hideous, yet always picturesque. However, amid all these strange sights there was one other which

interested me if possible even more, I mean the multitude, the variety, and above all the beauty of the butterflies. The first sight of such a thing as the big *Hypolimnas bolina*, L., black flashing with violet-blue, excited an emotion better imagined than described. At all events, the creatures took me fairly by storm: collect I must!

The resources of the bazár at Simla only produced a child's butterfly-net, a mere toy, scarce twelve inches in diameter and of a pale yellow colour! Armed with this and a tin cigarette-box filled with triangular envelopes I took the field. To this scanty equipment was shortly added a cyanide bottle. It was two months before the toy-net was superseded by an umbrella-net from Watkins and Doncaster. This last is a very convenient weapon for use in towns, or when travelling or sight-seeing. It is inconspicuous when rolled up, but can be quickly brought into action; it is however inadequate for serious work. In Calcutta I purchased a large Y-net with jointed canes, and had it fitted to the end of a landing-net stick that was made in two pieces that were six feet long when joined. A fair-sized net is required for large and swift butterflies, while for the many that habitually fly high and settle far from the ground, six feet is none too long a stick, though in narrow woodland paths it will be found unwieldy. Another time I should travel with a jointed stick of three segments, each three feet long. I may here add that mosquito netting is far more serviceable than leno, owing to its superior power of resistance to thorns of all sorts.

Mr. Otto Möller, of Darjiling, told me that he found it best to pinch all butterflies, even the smallest, but I found that Blues and Skippers were best "bottled." No doubt it would have been better to pin many moths, but my things were all enveloped in the way usual for butterflies, and the dates, localities, and any remarks that suggested themselves were inscribed upon the papers. [These data are still attached to the specimens.] Since getting back to England the insects have been serially numbered, and the data copied into a note-book. On another journey I should number the insects at the time, and while putting the more important data on the papers as before, copy these, amplified where necessary, into a book. This would, I am quite sure, save much time and result in a more complete record.

The insects were sent to England from time to time

by parcel post in small cigar-boxes, each enclosing a ball of naphthalene. In no case do they appear to have sustained any injury on the way. They have been beautifully set at Oxford by Mr. A. H. Hamm, and all that are worth preserving will be placed in the Hope Collection, while the explanatory note-book will be deposited in the library of the Department.

The total number of specimens sent home was as follows :—

	All countries.	*India and Ceylon only.*
Butterflies	1867	1494
Moths	206	125
Coleoptera	21	15
Hymenoptera	27	27
Neuroptera	15	5
Diptera	5	5
Hemiptera	10	8
Orthoptera	13	13
	2164	1692

In round numbers, I was five months in India and three weeks in Ceylon—say, six months together; during this time I took nearly 1700 specimens, of which 1500 were butterflies belonging to 204 species.

To these may be added the results of a fortnight in China, a month in Japan, and a fortnight in Canada, viz. 500 more specimens, and 64 additional species of butterflies, which are only incidentally alluded to at the end of this paper.

Naturally in a rapid tour of this kind there is small probability of turning up anything new, but it is hoped that some of the observations made (even on the commonest species) may throw a glimmer of light on some of those questions of Bionomics which are now attracting attention.

Simla, lat. 31° N., alt. 7200 ft.

In reference to the seasonal variation of many species it may be remarked that at Bombay on October 2nd and 3rd there was heavy rain, the tail-end of the monsoon. It was held to be a very late season, the rain had lingered and the cold weather was delayed.

My collecting at Simla was confined to a riding expedition along the old Hindustan-Tibet road. This is an

excellent riding-path along the watershed of the Sutlej and Jumna, cut at one time on the hot and dusty southern side of the mighty ridge, where the terraced slopes are covered with crops of maize, or ruddy millet; anon crossing to the northern side which is mostly clothed with fine forest of spruce, deodar, holm-oak and rhododendron—thus winding in and out, but for the 50 miles that we traversed always maintaining an altitude of from 7000 to 9000 ft. We went by way of Fágu, Theog, Matiána and Narkanda to Bághi, returning by the same route, except that from Bághi to Narkanda we walked over Mt. Huttú, 11,000 ft.* The expedition occupied eight days, but for simplicity of description I shall not distinguish between outward and return journeys.

The general aspect was decidedly autumnal; the nights were chilly and most flowers had gone to seed. There was more cloud than usual, and there were occasional slight thunder-showers. Most of the butterflies seen appeared to have been out some time, and were much battered. Two circumstances tended to restrict the bag—one, the fact that collecting was for the most part confined to a narrow mountain road, bounded by a precipice on the lower, and a cliff upon the higher side; the other, a limitation of wide application, that a tropical sun is not conducive to rapid pursuit.

Simla, alt. 7200 ft., to *Fágu*, alt. 8200 ft.

October 10th and 17th.

Gonepteryx rhamni, L., var. *nipalensis*, Dbl., was abundant throughout the journey, and so was *Aulocera swaha*, Koll., though in very poor condition; both occurred in Simla itself. The last named is a Satyrid having on the upperside a resemblance to our White Admiral, flying also with much of the grace of that favourite butterfly. It loves open spaces in woods, returning to the same spot when disturbed. When it settles on the ground, a rock, a flower, or a tree trunk, it often goes over on one side as much as 45° or even 50°. I saw one of these butterflies make three successive efforts, getting further over each time! On two distinct occasions I watched a butterfly settle twice, turning the first time over to the

* In Indian names "á" is pronounced as "a" in father, "ú" as "oo" in boot, "a" or "u" as "u" in but.

right, the second time to the left. I think there is no doubt that this "list" makes the insect less conspicuous.

Pararge schakra, Koll., is another common roadside butterfly in the Simla district; it closely resembles our *P. megæra*, L., but is larger. *Chrysophanus phlæas*, L., var. *timeus*, Cr., was also common; *Colias fieldii*, Mén., is sufficiently like our *C. edusa* to readily pass for that species; *Polyommatus bæticus*, L., is also suggestive of our South Downs, where it has been seen; the same may be said of *Argynnis lathonia*, L. Again, *Pyrameis indica*, Herbst., is very like our *P. atalanta*, L., though not so handsome and scarcely as graceful in its movements. So far there was plenty to bring to mind the fact that one was still within the Palæarctic Region. There were however a few insects to suggest the close proximity of the great Oriental Region, for if *Atella phalanta*, Dru., is very like a Fritillary (at least on the upper-side), and *Ilerda sena*, Koll., closely resembles a Hairstreak, on the other hand, the under-side of *Belenois mesentina*, Cr., is decidedly more brilliant than our Whites, while there is no denying that *Precis orithyia*, L., is quite Oriental in its aspect. This insect had struck me with admiration at Solon on the way up to Simla, and is called by the school-boys of India's summer capital, "The Ladies' Fancy." With the habits of a *Vanessa* or *Pyrameis*, there is something about the shape of the wings, the prominent ocelli, the brilliant blue of the hind-wings, and the leaf-like colouring of the under-side which gives it a very "tropical" appearance. However, one soon learned to look upon it as one of the most familiar butterflies of Northern India. At Fágu it was common, but like most butterflies which have a proclivity for settling on the ground, not too easy to catch.

At Fágu another butterfly of European aspect was common, *Vanessa kashmirensis*, Koll.; this is no credit to its name, but looks like an *urticæ*, L., that had been born and bred in the "Black country." But the Chalcosiine day-flying moth, *Agalope hyalina*, Koll., elegant in shape and quiet in colour, white, shaded with grey towards the tips, ochreous at the base, was quite a stranger.

Fágu, 8200 ft., to *Theog*, 7400 ft.

October 11th and 16th.

Before our start in the morning I found abundance of *Chrysophanus pavana*, Koll., in dry weedy corners of

cultivated ground; this is sufficiently distinct from *C. phlæas*, but has no especial oriental glamour.

From the ground by the roadside I picked up a large newly-emerged Bombyx with the awe-striking name of *Trabala vishnu*, Lefevre; it was unfortunately a good deal damaged in the killing, through having no oxalic acid available. Two Blues, *Cyaniris vardhana*, Moore, and *Zizera maha*, Koll., var. *diluta*, Feld., together with the Hairstreak, *Ilerda sena*, completed the bag for this stage.

Theog, 7400 ft., to *Matiána*, 7700 ft.

October 11th and 16th.

At Theog, our first halting-place, *Gonepteryx rhamni*, var. *nipalensis*, was especially common, and here I took my first *Athyma opalina*, Koll., a Vanessid resembling on both upper and lower surfaces *Limenitis sibylla*, L., an insect to which it is closely allied in structure and habits.

On the road, besides *Ilerda sena*, *Chrysophanus pavana*, *Precis orithyia*, and *Argynnis lathonia*, var. *issæa*, Moore, several things turned up. Of *Pyrameis cardui*, L., a fresh brood appeared to have emerged on the 15th or 16th October, and was common at the flowers of a straw-coloured thistle. I saw a few more *Athyma opalina*, and secured one. In their elegant floating flight one seems to see through the white markings of the butterflies of this genus. The Simla school-boys call them "Sailors," but to me the name "Ghosts" would seem more appropriate. They settle on the leaves of trees or shrubs, rarely affecting flowers. Here I got my first *Precis lemonias*, L., an insect with the habits (and structure) of a Vanessid, but with much the appearance of *Pararge ægeria*, L. A specimen of *Terias libythea*, F., taken on the return journey, bears the note "easy to catch," which is true, but at the time I do not think that I distinguished it from the much commoner *T. hecabe*, which it closely resembles.

At Matiána I found *Chrysophanus phlæas*, var. *timeus*; *Vanessa kashmirensis*; *Precis orithyia*; and two specimens of *Huphina nerissa*, F., both males. This last is a somewhat glorified *P. napi*, L.; one of them appeared to have a slight scent which I could not describe, but certainly it was not that of the male *napi*.

Perhaps the most abundant butterfly at Matiána, and indeed throughout the woods of the district, was *Cyaniris*

singalensis, Moore, very like our *argiolus*; it was in poor condition, flying about the tops of tall shrubs, but not seeming to affect either ivy or holly, although both were there.

Pararge schakra was especially abundant at Matiána and on the road thence to Narkanda. It differs from our *P. megæra*, L., in being larger and having more striking ocelli, though these are variable, one of my specimens, a female, having the ocellus near the tip of the fore-wing far larger than the rest. In its habits this insect sometimes reminds one of *P. megæra*, sometimes of *Satyrus semele*, L. It abounds along roads and in bare places, alighting almost always on the earth or on rocks, with its wings expanded (as with *megæra*), but when it settles down to rest the wings are raised, the fore-wings drawn back within the hind-wings, all that remains visible being the colour of dust. In no case did I see it turn on one side as *S. semele* does, but three times I observed it settle with its back to the sun, so as to reduce its shadow to a mere line; unfortunately I made this observation towards the end of my acquaintance with the butterfly, so was unable to make sure whether this was a mere chance or a definite habit. At any rate, I did not observe any instances to the contrary. I suspected in *P. schakra* the existence of a very slight sweet scent, that appeared to be unlike that of any other species.

At Matiána I beat out of alders a number of geometers, three *Philereme variegata*, Warr., and one *Cidaria niphonica*, Butl.; they had a jerky flight, which saved many of them from capture. A Deltoid, *Hypena tristalis*, Leder., came to light at night.

Matiána, 7700 ft., to *Narkanda*, 8800 ft.

October 12th and 15th.

Many of the same insects were met with as on the previous stage, but the following may be noted: *Terias hecabe*, my first specimen of the commonest species of a very characteristic Indian genus; *Ganoris canidia*, Sparrm., a White like *P. rapæ*, L., but with bigger black spots; and *Belenois mesentina*, flying fast and going straight ahead in a purposeful manner. Here I may remark that the swift flight of the Whites generally has much impressed me; it is evidently closely related to the fact that they are

quite the most conspicuous of all butterflies, especially at a distance. *Argynnis lathonia*, var. *issæa*, was again well to the front; another *Athyma opalina* was securely "papered," and a specimen of *Precis lemonias* was taken in which the anal angle of both hind-wings had been bitten off nearly symmetrically. Amongst many of the *argiolus*-like *Cyaniris singalensis*, Moore, one *C. vardhana*, Moore, was taken; also *Chrysophanus pavana*. Three geometers, *Phileremc variegata*, Warr., *Docirava æquilineata*, Walk., and the widely-distributed *Polyphasia truncata*, Hufn. (*immanata*, Haw.), complete the list.

At Narkanda *Argynnis lathonia*, var. *issæa*, was in great numbers in the woods, so was the Chalcosiine moth *Agalope hyalina*; this flies fast and always in the same direction, in this case up-hill and against the wind, more especially up certain gorges in the mountain side. It was hard to catch, and on the wing looked much larger than it is, but on settling vanished suddenly, burying itself in the herbage.

Colias fieldii was common, but was not remarkable for swift flight. *Terias hecabe* was also to be seen.

Narkanda, 8800 ft., to *Bághi*, 8900 ft.

October 13th.

The road through the magnificent forest, whence gaps in the towering spruces give inspiring glimpses of "The Snows" lying far away across the deep valley of the Sutlej, was at this season too dark and chilly to be the haunt of butterflies. At Bághi were *Atella phalanta*, *Neptis astola*, Moore, worn specimens of *Aulocera swaha*, and *Agalope hyalina*.

Bághi, 8900 ft., over *Mt. Huttú*, 11,000 ft., to *Narkanda*, 8800 ft.

October 14th.

Bághi, our furthest point, is but 26 miles W.N.W. of Simla, though by the winding mountain road it is fifty. The steep footpath up Mt. Huttú, when it has attained an elevation of a little more than 10,000 ft., emerges from the forest on to a flowery clearing that bore evidence of former cultivation. Here I saw *Colias fieldii*, *Atella phalanta*,

and *Argynnis lathonia*, and here I took two specimens of *Parnassius hardwickii*, Gray, one worn, the other in beautiful condition; it is a lovely creature, but the under-side has a curious resemblance to oiled paper. Delicate looking though it be, it is strangely tenacious of life. The concurrence of a "Clouded Yellow," a "Queen of Spain," and an "Apollo" was very suggestive of the Alps. All too soon the path plunged again into the now somewhat scrubby forest to come out finally, at near 11,000 ft., on to the grassy, flower-bedecked plateau in which the mountain culminates.

The Lha To, or rude altar of the degraded form of Buddhism that is prevalent in "The Hills," crowning the highest peak, reminded one of the High Places of Baal. The troops of butterflies seemed almost to rejoice in the glorious panorama of "The Snows" spread far around. The brilliant *Argynnis lathonia* was common, and the dingy *Vanessa kashmirensis* quite abundant—probably the more distant of yon white peaks to the left arises from its name-place, Kashmir. *Colias fieldii* was also in large numbers, a female exhibiting a symmetrical injury to the hind-wings very suggestive of a peck by a bird. *Precis orithyia* was there too, but *Aulocera swaha* was conspicuous by its absence. Of a humming-bird moth, much smaller than ours, *Rhopalopsyche nycteris*, Koll., I netted three specimens, one at the flowers of a delphinium. *Herbula cespitalis*, Schiff., reminded me of home. The Blues were represented by *Cyaniris singalensis*, Moore. A male *Terias hecabe* was of the wet-season form. I noted that this species is very easy to catch, and is brilliant on the wing; also that when settled on a shrub or flower it is usually extremely conspicuous, but not so when it chooses as its resting-place a certain low plant with oval leaves fading to a yellow tint; then the rounded form of the wings greatly aids its concealment. An old friend, *Euxoa corticea*, Schiff., was taken flying in the sunshine. I had several exciting chases after a big yellow Swallow-tail, and eventually secured one—my first *Papilio*! It proved to be our *machaon*, L., var. *asiatica*, Mén. Here, as in Japan, it scorns fens and dykes, glorying in mountain tops.

On the way down to Narkanda several *Pyrameis indica* disputed the path with our party.

The great resemblance to European forms presented by the bulk of the butterflies seen in this expedition cannot fail to strike the reader,

Solon, circa 5000 ft., to *Kálka*, 2184 ft.

October 20th, 1903.

Starting from Simla by starlight, soon after 5 a.m., we got to Solon by breakfast-time, and I there caught at 9 a.m. my first butterflies, two *alsus*-like Blues, *Zizera karsandra*, Moore, and *Z. maha*, Koll. Also two flies, a *Musca* of the *domestica*, L., group, and an Anthomyid.

On the drive from Solon to Kálka, by making the most of stoppages to change horses, and by occasionally jumping out of the carriage, I managed to secure quite a lot of things. Among the commonest was the beautiful *Precis œnone*, L., and with it *P. orithyia* and *P. lemonias*. Of *Atella phalanta*, *Belenois mesentina*, ♀, and *Ilerda sena*, I took single examples. *Terias læta*, Boisd., was rather common. There were also *Catopsilia pyranthe*, L., the *gnoma*-form, *Terias hecabe*, and *Huphina nerissa*. About two miles above Kálka, say at about 2700 ft., I got a single *Precis iphita*, Cr. At about the same place the great catch of the morning was made, for I took my first *Hypolimnas bolina*, three males and a female, believing them at the time to be two species. Why does not this glorious insect retain its far more poetical and more appropriate name, *Diadema jacintha*? Surely a black butterfly 3½ inches in expanse with four large glancing-blue spots, one on either wing, deserves to be called after a gem. Anyway, I shall never forget the impression produced by my first sight of its truly oriental splendour; it was like Kingsley's "At last!"

On my way down I also saw *Pyrameis indica*, and missed two Papilios, probably *P. machaon*.

At Kálka I got an hour and a half's collecting late in the afternoon; it was partly on waste ground about the station, but mainly in a field bearing a crop of some kind of pulse with thin pods 4–5 inches long.

A black and brown Cantharid beetle, *Mylabris sidæ*, Fab., was flying about flowers in the sunshine in large numbers. The genus *Precis* was represented by *orithyia* and *œnone*; the genus *Terias* by *hecabe*, *læta*, and quite a number of *libythea*. The inevitable *Atella phalanta*, never very common, and *Belenois mesentina* were to the front again. *Ganoris canidia* was fairly common; I noted that a male had a "snuffy scent." Single specimens of *Ixias marianne*, Cr., and *Huphina nerissa*, both males, were taken. Of *Cato-*

psilia pyranthe I took two females, one of which had suffered a symmetrical injury to both hind-wings. Three or four *Hypolimnas bolina*, both sexes, were disturbed in their first sleep, and being drowsy fell an easy prey. The Blues were represented by several species—*Zizera maha*, Koll.; *Z. otis*, Fab., var. *indica*, Murray; *Catochrysops cnejus*, Fab.; and *Nacaduba noreia*, Feld. Two Pyrales, *Hymenia recurvalis*, F., and *Bradina admixtalis*, Walk., and a worn Acidalid were picked up. A Sphinx, *Nephele hespera*, Fab., was taken during the afternoon at the flowers of a *Bryonia*. A little later on, an Arctiid moth, *Artaxa lunata*, Walk., came to the lamp of the railway carriage, to which a Sphinx, probably another *N. hespera*, also paid a momentary visit.

Peshávar, lat. 34° N., alt. 1165 ft.

October 22nd—25th, 1903.

This city is finely situated in the extreme north-west of the great plain of the Panjáb, or Five Rivers; the mountains of the Sufid Koh and the foot-hills of the Hindú Kúsh bounding the view to the west and north respectively.

In the hotel garden I took a few things; *Terias hecabe* was common, two of them lacked "the dog's head mark." *Belenois mesentina* was represented by a solitary male. One of three males of *Ganoris canidia* yielded a decided scent, hard to describe but certainly not that of *G. napi*. That dingy Skipper *Parnara mathias*, Fab., was abundant at the flowers of Duranta. I missed several specimens of a yellow *Papilio*, probably *erithonius*, Cr., and I believe one allied to *podalirius*, L. Of the Blues I took one *Polyommatus bæticus*, and three *Zizera karsandra*, Moore.

Two moths came to light, *Oligochroa akbarella*, Rag., and *Earias tristrigosa*, Butl.

Near the waterworks at Bára, amidst a wilderness of stones, I netted a female *Belenois mesentina*, three Blues, *Tarucus theophrastus*, Fab. (2 ♂, 1 ♀), and my first *Teracolus*, a female *etrida*, Boisd. Dr. Dixey tells me that he had no idea that this species ranged so far north. A strange-looking grasshopper, *Truxalis nasuta*, L., seemed well adapted to its stony desert surroundings.

From Pesháwar my most interesting expedition, from every point of view, was to Ali Musjid in the Khaibar Pass. This tiny white building, said to be the first

Musjid erected in India by the invading hordes of Muhammadan conquerors, stands about 2400 ft. above sea level. Close to flows a little stream full of fish and frogs, which produces an oasis among the hot dry rocks, where large beds of a species of mint attracted a number of butterflies, which I pursued under the strict and curious supervision of those good-natured barbarians, the Afridis of the Khaibar Rifles, who twice a week safeguard the caravans as far as Lundi Kotal.

Limnas chrysippus, L., was fairly common. I took two males and two females, one of the latter with pale ground-colour of an umbreous tint and much shading along the costa. *Pyrameis cardui* was the commonest butterfly, mostly in fine condition. I took one *Ganoris brassicæ*, L., of the form *nipalensis*, Gray, a female, and saw several *G. canidia*, which had all possibly strayed from a patch of cultivated ground hard by. The Clouded Yellows were represented by several *Colias hyale*, form *erate*, Esp. The beautiful *Precis orithyia* was quite abundant; *P. almana*, L., also occurred, but was not common. I saw several *Terias hecabe*. The Satyrids were the most interesting of all. A specimen of *Ypthima balanica*, March, was my first acquaintance in that elegant and delicately-made genus. *Satyrus parisatis*, Koll., a handsome insect suggestive of *Vanessa antiopa*, L., was rather common, but unfortunately much worn. Very conspicuous on the wing it did not appear to be attracted by the mint, but usually settled on the ground, and was then very difficult to see. I also secured two specimens of a very distinct pale Satyrid, much the colour of *C. pamphilus*, L., but much larger and with dentate hind-wings, *Epinephele davendra*, Moore; they were both ♀. I took two *Polyommatus bæticus*, but saw no Skippers.

Three of that widely-distributed beauty, *Deiopeia pulchella*, L., were seen flying in the sun, and with them a brilliant little Burnet, *Zygæna kashmirensis*, Koll.

Among the outsiders were a locust, *Pœcilocera picta*; a beetle, *Clinteria confinis*, Hope; two bees, *Bombus simillimus*, Smith, ♂ and ♀; and a wasp, *Vespa auraria*, Smith (☿).

Malakand, lat. 34° 30′ N., alt. circa 3000 ft.

October 28th and 29th, 1903.

By the kind hospitality of the Political Officer, Capt. R. W. E. Knollys, I was enabled to get two days' collect-

ing at this remote frontier post. Perched on a saddle, where the old Buddhist road crosses the foot-hills, looking forward over the Swat valley, back over the dusty plain of the Panjáb, this isolated fortress affords a picture of rocky desolation. The Pass is closed every night by *chevaux de frise*, and the garrison is always prepared for attack. When I went collecting it was deemed prudent that I should be accompanied by a gigantic *chuprassi*, a Pathan of the tribe of the Jusufsai, or Sons of Joseph. Moreover, when scrambling over the hillsides, in addition to the usual Indian thorns in all their varieties, wire entanglements have to be negotiated!

The rocky hills seemed too dry and burnt up to harbour many butterflies, but on the parched slopes of the fortified crag, nicknamed Gibraltar, the pretty little *Melitæa trivia*, Schiff., was almost abundant; on a glaucous shrub at the foot of the same hill were numbers of a glaucous green and yellow locust, *Pœcilocera picta*, which though conspicuous enough on the wing was decidedly cryptic. Other Orni-thoptera were *Quiroguesia blanchardianus*, Sauss., and *Truxalis nasuta*, L. I also took three wasps, two *Vespa velutina*, Lep. (var. "*des Indes*," Sauss.) ☿, and a ♀ *Polistes hebræus*, F.

In addition to the above a long and hot walk only yielded one *Ganoris canidia*, ♂; two *Terias hecabe*, a ♂ of the variety without the "dog's head," and a large but otherwise normal ♀; two Blues, a *Zizera karsandra*, Moore, and a *Z. maha*, Koll., var. *diluta*, Feld.; one *Precis orithyia*; a dingy Skipper, *Gegenes nostrodamus*, Fab., and a micro, *Tinægeria*, sp. Some puddles of water at the baggage-mules' drinking-place proved very attractive, yielding *Argynnis niphe*, a ♀, *Tarucus theophrastus*, F., a ♂, and the conspicuous *Hipparchia parisatis*.

The next day (Oct. 29th) I lighted upon an oasis in the desert in the shape of the staff-sergeant's garden, where irrigation had produced a brilliant mass of flowers, some vegetables, and a small field of lucerne. Here butterflies abounded: *Terias hecabe*, without the "dog's head mark," was in plenty among the lucerne as well as at the marigolds; the lucerne also yielded both *Colias fieldii* and *C. erate*, the eastern form of *hyale*. Among the Danaids *Limnas chrysippus* was common, and *D. genutia*, Cr., abundant at the marigold flowers, at which also one *Tirumala limniace*, Cr., was taken. *Athyma perius*, Linn., was rather com-

mon, but preferred the wet mud left in the irrigation channels to any flowers. *Argynnis niphe* was also common, but had more refined taste, and was usually taken on the marigold beds; its female was observed during life to resemble *L. genutia*. *Precis almana* was common; *P. orithyia* very abundant at the same flowers, together with a few *P. œnone*, one of them very fine and large. As usual in India *Atella phalanta* and *Belenois mesentina* put in an appearance, the first at marigold, the second (a ♂) among the lucerne. The Hairstreak *Ilerda sena* occurred alike at marigold and high up on the mountain-side. The flowers of *Gaillardia* proved more attractive to the smaller fry than the coarser marigolds; the brown Skipper, *Parnara mathias*, Fab., was in abundance, so were the dingy Blues, *Zizera karsandra*, Moore, and *Z. maha*, Koll., but the latter and its variety *diluta*, Feld., preferred mud to any flowers.

Other small things were *Polyommatus bæticus*, and the Skipper *Gegenes nostrodamus*, Fab., which was common at the flowers of *Gaillardia* and marigold. I saw this species at Malakand only, and unfortunately secured but two specimens. Two or three *Melitæa trivia* also turned up at these favourite flowers. Not far from the garden I took two more *Hipparchia parisatis*; this does not appear to be much attracted by flowers, but settles on the ground and is then often very hard to see. I observed it lean over from 20° to 30°, and even saw it walking about with a "list" of 20°.

Lahore, lat. 31° 35′ N., alt. circa 700 ft.

October 31st—November 4th.

At the capital of the Panjáb, a city of the plains, my chief collecting ground was the extensive Lawrence Garden, which though full of flowers is, in parts, so wild that, not to mention a mongoose, I even came across a jackal at midday. The class of butterflies found here differed widely from those met with at Simla and further north, the predominant forms being Oriental. Here I first captured *Papilio erithonius*, Cr., the "tailless swallow-tail," which I had perhaps seen at Pesháwar; this butterfly has a wide range in India and might almost be termed abundant, it especially frequents the flowers of *Zinnia*,

Lantana, and *Bougainvillea.* When feeding it settles for a few moments only, fluttering with its wings the while; then it is not hard to catch, but when rushing from place to place it is far otherwise. In colouring it is very like *P. machaon*, but far less handsome; the yellow ground-colour is often quite pale and bright when the insect is fresh, but it usually turns much darker and duller; I suspect that cyanide hastens this process. At Lahore also I first came across another very common Indian butterfly, *Papilio pammon*, L.; its graceful form and flight and rich velvety-black coat at first excited me so much that I had great difficulty in catching it! Naturally enough I followed Linnæus in taking the sexes for different species: he called the male *pammon*, and the very different female, Wallace's second form, *polytes.* At Lahore it especially affected the flowers of *Bougainvillea* and a shrub with blossoms like in colour and scent to, but much larger than, those of white jasmine. Like *P. erithonius* it flew rapidly from flower to flower and fluttered while feeding. The female taken here was of Wallace's second form (*polytes*); among the males was a dingy variety with scarcely any orange on the under-side of the hind-wings.

Limnas chrysippus was abundant, more especially at the flowers of *Asclepias* (the food-plant); amongst them was a dwarf female. *Tirumala limniace* was scarcely common.

Of *Catopsilia pomona*, F., I only netted one female, but believe I saw others; it visits flowers high up on trees. *C. pyranthe* was abundant; it flies fast and high and is hard to catch; it was fond of settling on the flowers of duranta on the tops of high hedges, forming a pretty contrast with the lilac-blue racemes.

Terias hecabe, both sexes, was fairly common; it flew slowly and near the ground. The black and white *Teracolus puellaris*, Butl., was also fairly common; perhaps it owes its name to the child-like simplicity of its dress. It flies near the ground, but so jerkily as to be somewhat hard to catch. It has the habit of flying *into* bushes, by preference those well provided with thorns, and not coming out again. Of *T. protractus*, Butl., I could only get two specimens; its salmon-pink colour with broad black margins dusted with blue-grey make it one of the most beautiful little butterflies that I came across; its dress is all in exquisite taste, the under-side being a quiet greenish-yellow that must greatly protect it when at rest,

White butterflies were not much in evidence; I took a somewhat worn female of *Appias libythea*, Fab., also two *Belenois mesentina*, both females. This last is another common Indian butterfly; its upper surface reminds one of *P. daplidice*, L., but beneath the hind-wings and tips of the fore-wings are bright orange with brownish veins. Experience at Lahore confirmed me in the opinion that "Whites" of all sorts are most difficult to catch; they are shy, and fly rapidly with a jerky vertical movement. "Whites" are by far the most conspicuous butterflies, especially when at a distance, and doubtless they need their swift wings. The Catopsilias are nearly as conspicuous as the true Whites, and they fly even more swiftly.

Among the Nymphalids the widespread *Atella phalanta* was represented by a few specimens at marigold flowers. *Precis orithyia* (an insect that suffers much loss of beauty from grease) was not common, the same is true of *P. almana*; a few of each were taken at flowers. At zinnia flowers I got my first *Hypolimnas misippus*, L., a male; it impressed me as a most tropical-looking insect, though not so gorgeous as *H. bolina*; it had both hind-wings clipped, possibly by a bird.

The Blues were represented by two species—the neatly-marked *Tarucus telicanus*, Lang., common at the flowers of *Plumbago*, and the little greyish-blue *Zizera maha*, Koll., abundant at the flowers of a species of millet and some herbs of the labiate family; amongst them was a specimen of the var. *diluta*, Feld. Blues swarm in India, many of the species are small and dingy, so that they are hard to follow on the wing, and their flight is even more jerky than that of Whites. They are often found on grassy banks as at home, but are especially addicted to water-drinking and are constantly present in irrigated fields and gardens. It must be confessed that the abundance of bigger game often led one to pass them by. Blues when killed are apt to fold their wings the wrong way, and it is difficult to set them right; but if only kept a short time in the bottle with a view to preventing this untoward result, they are apt to recover and fly away when the paper is opened after the day's work.

The dull-coloured Skipper *Gegenes nostrodamus*, Fab., was common in the gardens, but I only took one female. Small moths, especially Pyrales, were abundant in a patch of long grass and herbage in a damp spot. One of these

was *Pyrausta incoloralis*, Guen., another the tiny Gold-tail, *Porthesia marginalis*, Wk., which was flying in the sun. There was also the very widely-distributed *Marasmia trapezalis*, Guen.; but by far the commonest was the pretty little black-and-white *Hymenia recurvalis*, Fab. (very suggestive of our *E. cingulalis*, L.).

In the gardens of the Shah Dara, Jehangir's mausoleum, four miles from Lahore, I saw at dusk a number of Hawk-moths at the yellow tubular flowers of a small tree. My short-handled net only allowed me to catch two, which proved to be beautiful specimens of *Nephele hespera*, Fab., and *Chærocampa celerio*, L.

In writing to Dr. Dixey from Lahore I made the suggestive remark: "It is evident that being late in the autumn many of the butterflies are old and much worn. Curiously enough they are more often tattered and torn than actually rubbed." It is difficult to rightly apportion the breaking of the wings between the work of thorns and insectivorous foes. Certainly Indian butterflies fly into and through bushes in a way that one does not see at home.

In the Ajáib Ghar, or Wonder House of Lahore, Anglicé Museum, well known to readers of "Kim," is a small collection of insects. This was useful to me, but the destruction wrought by *Dermestes*, etc., both among the insects and the textile fabrics of the Industrial Collection, is most sad to see. I trust Mr. Kipling will see to it.

Amritzar, lat. 31° 40′ N., alt. circa 750 ft.

November 5th and 6th, 1903.

At the sacred city of the Sikhs my collecting was practically confined to two gardens close to the hotel. Here a large dull brown butterfly, with somewhat of the *Vanessa* habit, spread itself perfectly flat upon the surface of the earth and more especially of the damp mud of the little irrigation channels, lying so close to the surface as to be with difficulty discerned, so exactly did it resemble the tint of the mud. I secured three which proved to be *Euthalia garuda*, Moore, all females.

Papilio pammon was common; besides males I took one female of Wallace's Form I, which differs but slightly from

the male and is hence termed *pammon pammon.* Of *Precis almana* I took one, of the ubiquitous *Belenois mesentina* likewise one, a female, but I was somewhat surprised to net a *Colias fieldii*, ♀, since the great plain of the Panjáb seemed an unlikely locality for a *Colias.*

Yphthima nareda, Koll., was scarcely common in the hotel garden, it flew close to the ground. The list closes with *Polyommatus bæticus* and a grasshopper to which Mr. Kirby cannot assign a name.

Delhi, lat. 28° 30′ N., alt. circa 700 ft.

November 7th—12th, 1903.

When collecting in the Kudsia Gardens at Delhi it was impossible not to be impressed with the historic associations of the ground. Lying between the northern walls of the city, the famous ridge, and the mighty Jumna, scarcely more than a furlong from John Nicholson's grave, stands, nearly hidden by trees and flowering shrubs, all that is left of the Summer Palace of the kings of Delhi. Its crumbling walls, where not covered by Bougainvilleas or other creepers, bear testimony by many a bullet-mark and round-shot hole how fire-swept the place was during the long hot days of 1857. Concrete blocks with suitable inscriptions mark the sites of the breaching batteries of the last stages of the siege—batteries placed strangely near the walls when measured by the range of modern guns, for yon breach in the Water Bastion is scarce two hundred yards from the most advanced battery!

Here in a beautiful garden, the very ideal of quiet and peace, where the numerous grey-striped squirrels are quite tame and the greenest of parrots and the crested hoopoes look as if war were unknown upon earth—here I watched many gorgeous *Papilio aristolochiæ*, Fab., fluttering upon the flowers, or sailing over the trees; at one moment looking like black *crêpe* against the light, at another displaying a circlet of brilliant rubies beneath. Once I had three together in my net! With these were a few *P. erithonius* and *P. polytes*, the latter females of Form II.

Limnas chrysippus was also common, one, a male, was unusually small. *Crastia core*, Cr., was common in shady places under mango trees, but was rarely seen at flowers. The pretty little black and salmon-coloured *Teracolus*

calais, Cr., was abundant alike in the Kudsia Gardens and close to the hotel, flying near the ground yet not so easy to catch. One of them was very small. Of *T. puellaris* I only saw two. The "wet season" form of *Terias hecabe* was abundant, flying low and about bushes.

Of the brilliant yellow and orange *Ixias pyrene*, L., I took but one; the less gaudy Orange-tip, *I. marianne*, was rather common, but some of them were worn and none very easy to catch. The genus *Catopsilia* was represented by one worn male *pyranthe*, and I took my first *Delias eucharis*, Dru., a very worn female. The common Whites were *Huphina nerissa*, all males, and *Belenois mesentina*, which was abundant at flowers. The slender little *Nychitona xiphia*, Fab., flitted weakly along close to the ground, reminding me irresistibly of *Leucophasia sinapis*, L., in spite of all structural differences. One of these ghostly creatures was taken flying over a tablet that marked the site of "Battery No. IV. Left attack; mortars." One wondered whether there were any butterflies in that place during the terrible summer of 1857.

Three or four *Precis lemonias*, L., appeared to be rather fond of shade, they settled upon the ground in preference to flowers and then were hard to see. Of the gorgeous *Hypolimnas bolina* I saw one of each sex; it needed an effort to believe that they were one species.

The Blues included *Catochrysops cnejus*, Fab.; *Tarucus theophrastus*, Fab.; *Chilades varunana*, Moore; and *Chilades laius*, Cr., this last was common. The only Skipper taken was *Telicota augias*, L.

A little geometer, like a *Macaria*, was common among herbage, *Semiothisa fidoniata*, Guen., and one specimen of *Tephrinia disputaria*, Guen., was taken in like situation. *Semiothisa fidoniata* also came to light, along with *Oligochroa akbarella*, Rag. Can M. Ragonot have intended a deliberate insult to the memory of the great Emperor when he named this dingy and insignificant little Phycid after him?

Other moths taken in the Kudsia Gardens were the tiny Noctuids *Metachrostis badia*, Swinhoe, and *Earias tristrigosa*, Butl., which was common among bushes near a back-water of the Jumna.

In the verandah of the hotel I took a fine *Sphinx orientalis*, Butl., the eastern form of *convolvuli*, L.; it had probably been attracted by the lights the night before.

Lálkot. November 10th.

Eleven miles south of Delhi lies this glorious city of ruins, and there, under the shadow of the Kutb minar, flying over the stones and amidst the thorny vegetation were many Whites and Orange-tips. The butterflies appeared especially to delight in flying about inside the thorniest bushes, or even flying through and through them, so that torn wings were almost the rule. Prominent in the countless crowd of *Belenois mesentina* so employed were *Ixias marianne* and *I. pyrene*; a female of the former was distinguished by the substitution of cream-colour for white in the ground-tint of the wings. The delicate-looking *Teracolus etrida*, lover of ruins, was in abundance, flying close to the ground.

I saw one black *Papilio*, one *Limnas chrysippus* and one *Precis lemonias.*

Náini Tál, lat. 29° 30′ N., alt. 6500 ft.

November 16th—23rd, 1903.

Unlike Simla and Darjiling, which stand astride lofty ridges, Náini Tál lies in a basin by a lake, a situation which, however pleasant it may be in summer, gives it in late autumn a dank feel. In summer it affords good collecting, but in November I found but few insects and those mostly battered and forlorn looking. The fauna, though more Oriental than at Simla, a degree and a half to the north, was much more Palæarctic than at Lahore, which is yet half a degree north of Simla, but of course upon the plain.

A very clear picture remains with me of a bright sunny afternoon, with a raw chill in the air very suggestive of home. On the one hand were rhododendrons and Thujas growing as forest trees, and hard by cactus-like Euphorbias some fifteen feet in height; on the other, poplars were shedding their golden leaves in bright contrast to the crimson of the wild *Ampelopsis* (I cannot call it "Virginian" creeper), a "Brimstone"* butterfly dashes wildly past, then a belated "Tortoiseshell"† or "Red Admiral"‡ darts

* Probably *Gonepteryx rhamni*, var. *nipalensis*, but possibly a *Catopsilia*.

† *Vanessa kashmirensis.* ‡ *Pyrameis indica.*

up from the path only to return again to the same stone, while several "Small Coppers" (*Chrysophanus pavana*) disport themselves about the autumn flowers on the bank. Quite a Palæarctic picture surely!

In addition to these I found at Náini *Terias hecabe*, the Hairstreak *Ilerda sena*, Moore, and the Blue *Zizera maha*, Koll., also the Fossor, *Pompilus analis*, Fab., ♀, while *Agrotis flammatra*, Guen., came to light.

A climb to the top of China Peak (pronounced Cheena), 8568 ft., produced two more Palæarctic forms, *Argynnis lathonia*, var. *issæa*, and *Lycæna bætica*.

Five days were spent on horseback in an expedition into Kumáon as far as Ranikhet and Cháubattia, some twenty-four miles north of Náini as the crow flies. The road, at first slippery with ice so as to compel us to dismount, falls rapidly to Kháirna (Kháirana, or Khyrna, for the spelling seems uncertain). At about 6000 ft. *Ilerda sena* was again met with, at about 4000 ft. *Neptis astola*, Moore, and *Terias hecabe*. When near the bottom our eye was caught by the fluttering down of shells from a large pod-bearing tree. On looking up we saw about a dozen charming-looking greenish monkeys, their little black faces set off with most becoming white frills. It did not take them long to strip that tree of every pod.

At Kháirna, 3200 ft., a tiny village in a deep and narrow valley, I had a little time for collecting, but it was limited by the steady march of the great chill mountain shadow, which sent all butterflies quickly off to bed. *Precis orithyia* was common, but the specimens were very small; *P. œnone*, *P. lemonias* and *P. iphita* were also seen, the latter at flowers, not a usual habit of the species. Several *Athyma perius* were seen, also several *Catopsilia pyranthe*; of those taken one was the *gnoma*, the other of the *pyranthe* form. Of *Ganoris canidia* and *Tarucus telicanus*, Lang, I took one each, but *Zizera maha*, Koll., was in abundance. In addition to these were *Deiopeia pulchella*, flying for short distances about low herbage according to its wont, and a fly which hovered at flowers just like a Sphinx—a *Bombylius* not in the National Collection. The widely-distributed locust, *Thisoicetrus littoralis*, Ramb., which was very common, had the curious habit after its short flight of settling so brusquely upon a shrub as to make its branches shake, but then quickly making its way to the ground. I missed a *Macroglossa* twice at the same bush.

Late in the afternoon I took a *Papilio pammon*, a female of Wallace's Form II. *polytes*, which was flying about and into bushes, apparently seeking for a resting-place for the night, but possibly seeking where to lay its eggs.

Close to the village of Kháirna I saw upon the cliffs by the roadside several beautiful lizards, grey-spotted, with bright blue legs.

On the long and hot way up again from Kháirna to the ridge on which stand Ranikhet and Cháubattia, a dwarf *Precis orithyia* and a *Neptis astola*, Moore, were taken at about 3500 ft., and at about 4000 ft. *Belenois mesentina*, *Pyrameis indica*, and *Ilerda sena*.

At Ranikhet, 6000 ft. (where, by the way, the cooking at the Dák Bangla was the best that we came across in India), monkeys were not uncommon in the woods, but unlike our legumen-loving friends of Kháirna, of a revoltingly ugly type; butterflies, however, were scarce, and were represented by *Pyrameis cardui*, *Vanessa kashmirensis*, *Ilerda sena*, and *Lycæna maha*, Koll., var. *diluta*, Feld.

At Cháubattia, four miles to the east of Ranikhet, and at a height of about 6200 ft., the officers' quarters command a most glorious panorama of Nanda Devi, 25,749 ft., Nanda Kot, 22,491 ft., and Trisúl, 23,581 ft., mountains of unsurpassed grandeur of form and held most sacred by pious Hindus as sources of Holy Ganges. These stand between fifty and sixty miles away, yet shine forth as clear and bright as if close to. Here there were rather more butterflies, viz. our old friends *Terias hecabe*, *Precis œnone* and *P. lemonias*, *Pyrameis cardui*, and *Chrysophanus pavana*, and in addition something quite fresh, the Erycinid *Dodona durga*, Koll., of which I got three specimens; though a small insect it proved tenacious of life. A little beetle, *Oides sp.*, was taken flying over the road.

On descending again from Náini to the plains one found, as at Simla, that butterflies got more numerous and more Oriental in character. At the top of the road the Hair-streak, *Ilerda sena*, was common; at 5000 ft. *Yphthima philomela*, Joh., was met with; at the Brewery, *circa* 4500 ft., butterflies were very common at a flowery turn of the road, and I took *Pyrameis indica*, several *Precis iphita*, *P. lemonias*, and a male *Hypolimnas bolina*, while I missed a brown-and-white *Neptis*-like butterfly which may have been *Rahinda sinuata*, Moore.

Lucknow, lat. 27° N., alt. circa 500 ft.
November 24th and 25th, 1903.

Lucknow possesses a museum containing a fair collection of insects, which would have been more instructive to me if a majority of the species had been named.

My scanty collecting was almost confined to public gardens. Near the hotel was a small institution, either a children's orphanage or hospital, and in the garden attached thereto *Hypolimnas misippus*, ♂, was rather common, but shy and worn; I took a battered one. Of *H. bolina* I took a female. Of *Delias eucharis* the males were common at *Zinnia* flowers. Odd specimens of *Papilio aristolochiæ* and *Parnara mathias*, Fab., also occurred.

In the beautiful garden of the Dilkusha Palace, where Havelock fell sick of the illness that was to prove fatal in the very hour of triumph, there was a great wealth of flowers and consequently a great assemblage of butterflies. Besides such things as *Papilio erithonius*; *Argynnis niphe* (a ♀); *Hypolimnas misippus*, several males; *Crastia core*, both typical and the variety *vermiculata*, Butl.; and a *Catopsilia* which evaded capture, I took there my first *Rapala melampus*, Cramer. This is a small copper-coloured butterfly belonging to a genus which, with its robust body, sharp-cut wings, and curious anal lobe to the hind-wing, looks very different from our Hairstreaks or Coppers. It is neither easy to see on the small flowers which it frequents, nor to catch.

Other butterflies taken in the same garden were the Blues *Catochrysops strabo*, Fab., and *Tarucus telicanus*, Lang, the latter abundant; *Mycalesis perseus*, and the brilliant tawny Skipper *Telicota augias*, L. A beautiful little Noctua with yellow under-wings, *Hyblæa puera*, Cram., was taken at flowers in full sunlight. The Blue *Zizera argia*, var. *similis*, Moore, was in abundance. I also took a locust, *Gastrimargus marmoratus*, Thun., a species of wide distribution.

By the roadside between Dilkusha and La Martinière a few *Chilades putli*, Koll., a very small brown Lycænid, were obtained.

At the Alumbagh, ever to be remembered in connection with Colin Campbell, the dry-season form of *Terias hecabe* was flitting quietly about, and I netted *Ixias marianne* (not so vulgar-looking as its name might lead one to

expect), also a variety of the female of *I. pyrene* without the orange-tip. A male of the wet-season form of *Huphina nerissa* was also taken, while *Delias eucharis* was common, a specimen feeding on *Zinnia* flowers close to Havelock's grave. *Deiopeia pulchella* was flying commonly in the sun amongst the grass, and with it a specimen of *Argina cribraria*, Clerck. The Coleoptera were represented by *Mylabris sidæ*, Fab., and the Micros by a Pyrale, *Pyrausta juncturalis*, Wlk.

In the Presidency garden I took only a worn *Acidaliid* and the common Cantharid beetle, *Mylabris sidæ*, Fab., which was seen in some numbers flying about the flowers of a species of *Hibiscus*.

Benares, lat. 25° N., alt. 270 ft.

November 28th—December 2nd, 1903.

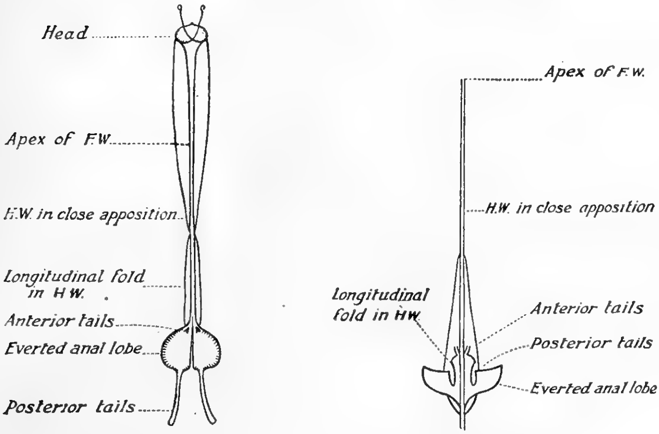
The sacred city of the Hindus proved more remarkable for the number and variety of its pilgrims than for its butterflies. In the hotel garden, where jackals howled loudly by night, a few battered specimens of *Papilio erithonius* were seen by day, and the males of both species of *Hypolimnas* were fairly common. Of *H. bolina* I took a fine female, while of *misippus* I also sent home a female which is marked "common." It is, however, certain that I did not know this insect to be a *Hypolimnas* at the time, since I only learned from the Calcutta Collection that the female of *misippus* was brown! There is therefore little doubt that I took it for a variety of *Limnas chrysippus* which it mimics in such a surprising manner, and which certainly was common enough in the same garden. It is one of the inconveniences of the method of enveloping that so much is left to memory, and the chances of comparing insects are so very few. Dwarfed specimens of *Precis orithyia* were now very common; *P. œnone* and *P. lemonias* were less common but almost as small. Several *P. almana* occurred. But in spite of the excessive drought and the consequent occurrence of dwarfs, one of my specimens of *Terias hecabe* taken at Benares was quite of "wet-season" type. *Catopsilia pomona* was represented by a very large male of the typical form and a smaller female in fine condition, exhibiting the transition to the *catilla*, Cr., or extreme dry-season form. Similarly *C.*

pyranthe was represented by a male of the typical and a female of the *gnoma* form.

Together with the above were several smaller things: among the Blues *Polyommatus bæticus* occurred, while *Catochrysops strabo*, Fab., and the tiny *Chilades putli*, Koll., were both common. The Skipper *Parnara mathias*, Fab., was also common, and I took one *Telicota augias*, L. The little Pyrale, *Hymenia recurvalis*, was in some numbers in one small flower-bed. Of the long-waisted wasp, *Eumenes esuriens*, F., I saw but one ♀.

APHNÆUS ELIMA, Moore.

Enlarged from sketches from the living butterfly.



Diagrammatic view from *above*.

Diagrammatic view from *behind*.

Drawn at Benares, November 30*th*, 1903, *by* G. B. LONGSTAFF.

But among the frequenters of the small garden adjoining the hotel those that interested me most were the "lobed" and "tailed" Lycænids, of which there were no less than four species. Of *Aphnæus ictis*, Hew., I took but one, a male, of *A. elima*, Moore (which, however, De Nicéville considered to be only a dry-season form of *ictis*), I secured two, also males. Of the third species, *Pratapa deva*, Moore, I took but one, and that had lost the anal angles, with their appendages, and a large part of both hind-wings, which had apparently been bitten off, absolutely symmetrically, by a lizard. The fourth species, *Rapala melampus*, Cramer, was common, and I secured seven specimens, all, however, males.

Concerning *R. melampus* I wrote to Dr. Dixey at the time: "The Tailed Copper (or Hairstreak) first seen at Dilkusha, Lucknow, and found commonly here to-day, greatly interests me. Not only is it very beautiful, but it is surprisingly hard to see, especially when at rest. Then the structure of the hind-wing is most strange; posterior to the tail (the next interspace but one) a portion of the wing nearly circular, with a very obvious fringe of large scales, is set at right angles to the plane of the wing and to the direction of the veins."

According to Schatz and Röber * this "anal lobe" occupies the space between the sub-median and inner marginal veins; the second anal and third anal of Comstock; 1*b* and 1*c* of Meyrick; but I have not found in these authors any allusion to the striking fact that this lobe is quite out of the plane of the wing. This omission may be due to the fact that the process of setting usually flattens the lobe out so that it is hardly seen in cabinet specimens. It did not occur to me at the time (and the suggestion arrived by letter too late) that the object of this structure is possibly to produce the appearance of a head in a non-vital part, the tails representing the antennæ. However, drawings made at the time strongly bear out the suggestion. The resemblance would be still more striking if these Lycænids, like so many of the family, habitually rest with the head downwards.

In another letter from Benares I said: "Thorns are not specially bad here, only that one does not know the look of many thorny plants until too late. But, on the other hand, burrs of every sort and kind abound to an incredible degree and tangle up the net; much of one's time is spent in freeing net and breeches therefrom."

It might have been added that at Benares I first made acquaintance (somewhat intimate) with "spear-grass," which is yet more provocative of bad language than either thorn or burr.

Some three miles from Benares, on the way back from Sarnáth, where Buddha first taught, I found *Delias eucharis* in extreme abundance in a small field of the tall marigold which is so much cultivated for the service of the temples. A truly gaudy sight it was to see crowds of these white, yellow, and scarlet butterflies upon the orange-coloured blossoms.

* *Die Familien und Gattungen der Tagfalter.*

Calcutta, lat. 22° 30′ N. Near sea-level.
December 4th—12th, 1903.

Naturally one could not expect to turn up anything new at Calcutta, the capital of India, and long the home of De Nicéville, that martyr to science who met his death in the deadly Terai when in pursuit of his favourite butterflies. However, I determined in the few days at my disposal to get at any rate a sample of the fauna of Lower Bengal.

The Eden Gardens, abutting on the Máidán and close to Government House, bear much the same relation to Calcutta as Kensington Gardens to London, and from their proximity to the hotel afforded a convenient collecting ground for odd hours.

The *Duranta* was nearly over and the most attractive feature proved to be a hedge of *Lantana* in full bloom. These dissimilar plants both belong to the *Verbenaceæ* and are both natives of the West Indies, although the latter appears to have run wild in many parts of India. On that hedge *Limnas chrysippus* was in abundance, accompanied by *L. genutia,* which I had not seen since I was at Malakand, while numerous *Tirumala limniace* and *Crastia core* completed the company of the Danaids. I was able to confirm my Benares observation that the male of *L. chrysippus* has a slight but decided odour suggestive of cockroaches, which is perhaps stronger when the scent sacs on the hind-wings are opened, though of this I am not sure. On the other hand, the male of *C. core* has a faint scent that suggested to me rancid oil, or old lamps. So far as I could judge the scent is connected with the hind-wings but *not* with the very conspicuous genital tufts.

At the *Lantana* flowers along with the Danaids were abundance of *Suastus gremius,* Fab., a somewhat dingy Skipper, also a few of the brilliant and conspicuous *Delias eucharis.* The upper-side of the female of this species faintly mimics *Tirumala*; the male yielded on rubbing the wings a sweet flowery scent, which I was not at first able to describe, but later it struck me as resembling that of our domesticated *Ganoris rapæ* and suggestive of sweet-briar. Dr. Dixey informs me that scent-scales are very numerous in *Delias.*

In the shadier parts of the garden together with numerous *Terias hecabe,* one at least of markedly wet-season type, and many *Yphthima hübneri,* Kirby, several *Nychitona xiphia* were found, which, as ever, reminded me of

Leucophasia sinapis, a slender form and fragile appearance being in each case associated with a weak flight close to the ground. One of the *Y. hübneri* had the whole hind margin of both secondaries bitten off nearly symmetrically.

Catopsilia pyranthe and *C. pomona* were both met with, the former the more frequently. No *Papilio* turned up although I was told that *P. pammon* occurs in the garden. Amongst young palms the males of *Elymnias undularis*, Dru., were occasionally disturbed, and a very striking thing it is. Then *Nepheronia hippia*, F., came along, flying strongly, the male looking on the wing, or more especially when settled on a flower with wings expanded, much bluer than its cabinet appearance might lead one to suppose. Three *Limenitis procris*, Cr., required some catching, preferring the leaves of tall shrubs to flowers; but it is scarcely as graceful on the wing as our White Admiral.

I took two specimens of *Catochrysops pandava*, Horsf., var. *bengalia*, De Nicév. (being the dry-season form); the female is a dingy creature, but the male is of an iridescent blue, bordered with black. *Hypolimnas misippus*, ♂, *Precis almana* and *P. lemonias* completed the list of twenty species taken in four visits to the gardens. With them was a bee *Elis thoracica*, Fab., a ♀.

Báliganj.

At the truly splendid museum (where, by the way, I saw a native artist at work producing some of the very best coloured figures of beetles and butterflies that I have ever seen), Mr. S. E. Peal, besides helping me in other ways, put me on the track of one of the late Mr. De Nicéville's favourite collecting-grounds, a *rus in urbe*, at Báliganj, a suburb only three miles from the hotel. I visited this place twice, on December 5th and 9th. It consists of a large deserted garden long run wild; weedy meadows and jungly woods are all that is left of trim lawns and ordered shrubberies, while a palm avenue and several tanks covered with a floating flower of the convolvulus order, harbouring countless dragon-flies, complete the tale of departed greatness. Altogether it is full of sad beauty. Palms and crotons with an undergrowth of ferns were the characteristic plants, flowers were few, yet in certain favoured spots butterflies were in quite bewildering swarms. The quiet charm of this old garden was greatly enhanced by the absence of curious natives and the (comparative) absence

of burrs, that curse of "up-country" collecting, though the unsuspected prickles of innocent-looking palms to some extent took the place of the latter.

Some of the species seen near the centre of the city, in the Eden Gardens, were conspicuous by their absence, e. g. *Limenitis procris, Precis lemonias* and *Hypolimnas misippus.*

The four common Danaids, *Tirumala limniace, Crastia core, Limnas genutia* and *L. chrysippus,* were not so common as might have been expected, probably owing to the scarcity of the flowers they love. In the last-named species I was able once more to confirm the presence of a distinct, but not strong, odour suggestive of cockroaches. A few *Papilio polytes,* both sexes, gave to the assemblage that air of distinction which the genus always has. Among the more sombre things, most frequent under the shade of groves, were a number of *Mycalesis indistans,* Moore, together with one *M. perseus,* Fab., which so far as observed have no "list" when at rest. In the shade also were two or three *Melanitis ismene,* Cr. Close down among the herbage together with *Yphthima hübneri* there were flying large numbers of *Y. philomela,* certainly a gregarious species.

Precis almana was noted and *P. atlites,* Joh., here came under my observation for the first time, but in poor condition; it is then a rather ghostly-looking butterfly though a somewhat strong flier; this last is also true of *Atella phalanta.* A single specimen of my old Amritzar friend *Euthalia garuda* was observed, as before, to settle with its wings fully expanded and closely appressed to the ground. *Elymnias undularis* was in abundance ; it is especially addicted to the characteristically Indian butterfly habit of flying into or through bushes, and even of flying about inside bushes. It is clearly gregarious, several specimens flying about and in one palm-bush, its food-plant. The male is very striking on the wing, and when settled, even though the under-side is somewhat leaf-like, it is yet quite conspicuous. The female, on the other hand, is on the wing a very fair mimic of *Limnas genutia,* but its flight is weaker.

Catopsilia pyranthe and *C. pomona* were both rather common ; *Terias hecabe* was abundant, and, as usual, gregarious.

In half-shaded spots an occasional *Nychitona xiphia* flitted slowly along close to the ground. *Ergolis ariadne,*

L., was abundant, of *E. merione*, Cr., two specimens were secured. The butterflies of this genus settle with the wings three-fourths expanded.

Nepheronia hippia was rather common; though its female somewhat mimics *Tirumala limniace*, the male, when on the wing, looks much bluer than that insect.

A brilliant fulvous Skipper, *Telicota bambusæ*, Moore, was the only representative of the group, but there were several Blues, to wit *Catochrysops strabo*, Fab., which was common; *Lampides celeno*, Cr., larger than usual, one being of the form *alexis*, Stoll.; and *Neopithecops zalmora*, Butl., was common. A single example of *Curetis thetys*, Dru., fell to my net, apparently bitten by some enemy; its silvery white under-side is very striking. But perhaps the strangest-looking butterfly of the lot was *Loxura atymnus*, Cr., of which I got two. Its wings are much plaited longitudinally, and when at rest its extremely long tails, crumpled look, and brown colour give it quite the look of a dead leaf. A closer examination shows that the portion of the hind-wing near the anal angle is bent down, or back, nearly to a right angle; this bent portion is, however, relatively smaller, more oval and less sharply bent than the rounder anal lobes of *Rapala* and *Aphnæus;* moreover it is not furnished with the very large marginal scales which are so conspicuous in those genera.

Toliganj. December 7th, 1903.

About two miles from Báliganj, and due south of Calcutta (about half-a-mile beyond the Sports Club), is the locality referred to as Toliganj. Here too is an old abandoned garden, but lacking the elements of departed grandeur that give a poetic colouring to De Nicéville's old hunting-ground. The prominent features are a great profusion of *Lantana* in full bloom, a bamboo grove and a good deal of thorny jungle. The day that I was there the *Lantana* was the chosen haunt of great numbers of the bigger butterflies such as *Delias eucharis, Tirumala limniace, Limnas genutia, Papilio pammon,* mostly worn, *P. aristolochiæ*, and a few *P. erithonius*, together with an occasional *Nepheronia hippia*, with his broad wings proudly expanded to view. The sight of these big fellows, expanding from three to four inches, quietly settled on the flowers, or fluttering after the manner of *Papilio*, or grandly sailing around gorgeous in their white, yellow and scarlet,

black and grey blue, mahogany-brown and black, black and cream colour, black and coral-red, black and yellow, or sky-blue and black, afforded indeed a glorious sight not soon to be forgotten. Alas! such a tropical glory takes much colour out of the most vivid mental pictures of butterfly life at home.

In a shady grove not far from these flowers *Limnas genutia* was simply swarming, as many as ten or even twenty being in sight at once, for it is one of the most gregarious butterflies that I have met with. A few observations on this species and *Tirumala limniace* failed to detect any odour, but it was far otherwise with *Delias eucharis*, of which several specimens had a distinct sweet scent, very like that of *G. rapæ*. My strong impression is that this scent is confined to the male, but I cannot, unfortunately, speak with certainty on the point. The male of *Huphina nerissa* has a distinct scent, also like that of *G. rapæ*, although the butterfly more resembles *G. napi*. The scent of these two butterflies is neither so strong nor so unmistakably characteristic as that of *G. napi*, but its existence is quite beyond question.

These scents are not easy to deal with. The human nasal organ is but a poor affair at best, moreover scents are very hard to describe, and these butterfly odours are only suggestive of, certainly not identical with, those to which I have, for want of any better standard, compared them. Then the scents are transient and may easily be scattered by the wind or overpowered by neighbouring flowers. Again the scales, independently of any scent, are irritating to the mucous membrane. Lastly, any one who has tried to use the sense of smell for diagnostic purposes must know how even the most volatile perfume is apt to linger on, lurking as it would appear in the cavernous recesses of the nose. Of course it is much easier to determine in the field whether or no a scent is sexual in those species in which the sexes are distinguishable by very obvious characters. Lastly, it should never be forgotten that in all probability the scents described are far more obvious to the insects themselves than to human observers.

Only a solitary representative of the *Euplœa* group appears among the Toliganj specimens, but its envelope bears the note: "Common, has a slight peculiar scent, rather disagreeable." Most probably I believed this at the time to be the common Calcutta species *Crastia core*, but it turns out to be *Pademma kollari*, Feld., and it is now

impossible to say what those that I passed over or missed were.

In variety the Toliganj flies were disappointing, but, besides the above named, they included a very fine female *Ixias pyrene*, the sole Orange-tip seen at Calcutta; a few *Catopsilia pyranthe*; several *Ergolis ariadne*; *Elymnias undularis*, not common; plenty of that very distinct Blue, *Neopithecops zalmora*; a single specimen of *Loxura atymnus*, and plenty of *Yphthima hübneri*, *Y. marshalli*, *Y. philomela* and *Nychitona xiphia*.

The list is closed by "*Melanitis ismene*, lover of darkness, as its name seems to say. It flitted about everywhere dressed in all the tints of fallen leaves, or, alighting among them, fell partly on one side and was one of them." * I quote the words of E. H. A., that keen observer and telling writer. The few specimens that I saw that day were very dark and of the "dry season" form. A note made at the time says: "This shade-loving species, which only flies for a *very* short distance and settles on the ground, has a 'list' to the right of 20–30°, making it very like a dead leaf."

A parasitic bee, *Crocisa histrio*, Fab., was caught feeding on the wing like a Sphinx.

On December 8th, I visited the grand Botanic Gardens at Howrah, but it was too late in the day for many butterflies to be about. I noted, however, *Lampides celeno*, Cr.; *Mycalesis indistans*, Moore, a *Delias* and two or three *Terias*. Late in the afternoon, just before leaving the gardens, I noticed a few *Limnas genutia* fluttering about a palm-tree prior to settling down for the night. On looking carefully I noted on one of the huge leaf-stalks, some twelve or fourteen feet from the ground, a *cluster* of the butterflies *hanging together like swarming bees*. By pelting with sticks and stones the cluster was broken up and proved to consist of at least seven or eight individuals. Altogether there were perhaps twenty in and about that tree. This certainly establishes for *L. genutia* the character of gregariousness. Both Mr. S. E. Peal and Mr. F. Möller told me that they had never seen such a thing.

Darjiling, 27° N., alt. 7000 ft.

December 13th—22nd, 1903.

I set off to this celebrated hunting-ground with great

* "A Naturalist on the Prowl," p. 203.

misgivings as to season, but still full of wild hopes. The ascent by the cog-wheel railway took us through a most interesting forest, where amongst other things we saw our first tree-ferns. Near Tindaria, at about 3000 feet, I saw several *Ixias pyrene* and succeeded in catching one from the train while it was going at full speed—about seven miles an hour! This was a male of the large form *evippe*, Drury.

Before reaching Kurseong, nearly 5000 feet, where I had arranged to sleep with a view to getting a little collecting, we got into the clouds, and at our destination it was very cold, with an atmosphere only too like that of the West of Scotland. During a gleam of sunshine I took a *Vanessa kashmirensis*, a poor dull thing compared to our *urticæ*. At night two moths, an Acidaliid, *Synegiodes hyriaria*, Walk., and *Caradrina albosignata*, Oberth. (thought by Sir G Hampson to be probably identical with *lineosa*, Moore), came to light.

The following morning was brighter and we started early to walk up to the next station, Toong, but though the weather was more benignant, the railway ran through a district devoted to tea-growing which did not promise well. A few *Vanessa kashmirensis*, a *Pyrameis indica* and a *P. cardui* flew along the road, the latter with both apices of the fore-wings and one hind-wing near the anal angle apparently bitten. Near Toong station, 5500 feet, in a sheltered and flowery spot I took single specimens of the Hairstreaks *Ilerda epicles*, Godart, a female, and *Camena cleobis*, Godart; the latter on the upper surface like *T. quercus*, but bluer, on the under-side almost white with a practically black spot on the anal lobe. Here also I took a male *Hiposcritia lalage*, Dbl., and a native caught in his fingers a *Dodona eugenes*, Bates (an Erycinid), and the same man brought me a fine Saturnid moth, *Rhodia newarra*, Moore, 6½ inches in expanse, apparently recently dead.

As the train rounded the last corner we came in full view of the Kangchinjunga range, rising majestically full four miles above us. No words can describe the grandeur of the scene and we were fortunate indeed in having it clear throughout our stay. Yet, entomologically speaking, it was the saddest of disappointments, for it was as cold as England in November and the local entomologists—Messrs. Möller and Lindgren—assured me that *Kallima* was hopelessly over, as indeed were most things. They, and every one we met, spoke of the astonishing multitudes of

butterflies in the rainy season ; the harder it rained, they said, the more insects there were in the short interludes between the showers.

On the high ground I got little ; *Vanessa kashmirensis*, *Pyrameis indica* and *cardui*, none of them common, also a brilliantly-coloured beetle, a species of *Cassida*. I saw a school-boy catch *Colias fieldii* and a tailed "blue." At Jalapahar, 7500 feet, I got a female *Huphina nadina*, Luc. [=*remba*, Moore].

The only chance was to go down into the valleys, but it takes long to descend, and as the butterflies are for the most part only "at home" from 10.0 a.m. to 2.0 p.m., one does not get many hours' collecting ; moreover, from those precious hours there are deductions to be made for cloudy times, and for the shadows of woods, and the still deeper shadows of lofty mountains.

My first expedition, lasting three days on horseback, was to the Tista valley, lying to the east of Darjiling. December 17th, we went to Pashók, about 17 miles, sleeping at the Public Works Department rest-house, about 2300 feet above the river, and about 3000 feet above the sea.

When we got down to about 4000 feet above sea-level insects began to get fairly numerous, although it was late in the day for butterflies. *Vanessa kashmirensis* was common, and with them were several *Pyrameis indica*. I secured two of the handsome White *Hiposcritia lalage* [=*argyridana*, Butl.], both females. Several *Neptis astola*, Moore, were seen, mostly worn. At a shady turn of the road I got *Lethe rohria*, F., an *ægeria*-like Satyrid butterfly ; close by *Arhopala areste*, Hew., flashed azure in the sunlight, but a specimen of another beautiful Lycænid, *Spindasis vulcanus*, F., was badly battered. Of *Abisara flegyas*, Cr., and *A. fylla*, Doub., I netted one each, and a large bee, *Bombus funerarius* ?, Smith, a ♂, tempted me to catch him.

In the wood in which the rest-house stands *Mycalesis indistans*, Moore, was in abundance ; this is a typical shade-lover ; when kicked up from the herbage it flaps about three yards, like *Epinephale janira*, L., and then settles on dead leaves or on the earth. Some of them had a slight "list," but this did not seem to be a marked habit, possibly because this position is not so advantageous in shade as in sunlight, though the habit was first noticed in *Melanitis*,

a typical shade-loving genus. The existence of shade-loving butterflies would seem to be correlated to a tropical sun, but even in England *P. ægeria* and *E. hyperanthus*, L., still more *L. sinapis*, are what I should term "partial shade-lovers."

In the same wood, also in the shade, *Terias læta* and *T. hecabe* were both common, and in sunnier glades the common Indian Blue, *Lampides celeno*, Cr., was both abundant and gregarious. In a young cinchona plantation close by I found *Ganoris canidia*; a Blue, *Cyaniris puspa*, Horsf.; and a handsome very large Skipper, *Celænorrhinus leucocera*, Koll. In the rest-house there was a dead Pyrale, *Lepyrodes geometralis*, Guen.

The next day, December 18th, I sent my pony on ahead, and walked down to the river collecting on the way. In the cinchona plantation close to the rest-house I found *Zemeros flegyas*; lower down were *Euthalia appiades*, Mén., of which I saw several worn specimens; a Hairstreak, *Arhopala bazalus*, Hew., like a glorified *T. quercus*; *Lethe verma*, Koll.; and *Melanitis ismene*, the last as usual a shade-lover.

A path leading off through the wood brought me to a tea-garden, perhaps 1500 feet above sea-level, where I lingered all too long. Tea-gardens are not as a rule good places for butterflies, and the flower of the tea-plant, then just coming out, does not appear to have attractions for them, but this particular garden, just at the edge of the forest, and especially that corner of it where the little stream runs in, was certainly very prolific.

Athyma ranga was in abundance, though worn; likewise its relatives of the genus *Neptis*, but the three specimens that I sent home belonged to as many species: *N. aceris*, Cramer; *N. astola*, Moore; and *N. varmona*, Moore; the closely allied, but brown and black, *Symbrenthia hyppoclus*, Cr., was almost as common among the tea-bushes. Of the satin-winged *Hiposcritia indra*, Moore, I took two females. Of the following I got single examples only:—*Caduga melaneus*, Cr., and the very similar *Parantica melanoides*, Moore, two black and white Danaids; *Athyma selenophora*, Koll.; *Yphthima philomela*, Joh.; *Arhopala centaurus*, Fab.; and *Castalius anaura*, De Nicév., ♀, while another Blue, *Lampides elpis*, Godt., pale and beautifully sheeny, was common. I also missed what was, I believe, *Libythea rama*, Moore. There were in

addition two moths, an Arctiid, *Leucoma submarginata*, Walk., and a Nyctemerid, the fuscous-and-white *Zonosoma cenis*, Cram. (= *interlectum*, Walk.), the former possibly, the latter certainly a day-flyer.

At last I dragged myself away and an hour later reached a most attractive flowery bank immediately above the river. This was evidently a great place, for in a very short time I secured two sadly battered *Papilio memnon*, L., of the form *agenor*, L.; a large male *Ixias pyrene* with the fore-wings almost symmetrically bitten near the tip of the costa; also an insect that I had greatly desired to take, the lovely and delicate-looking "map-butterfly," *Cyrestis thyodamas*, Bdv., in splendid condition. This, a Nymphalid, by the possession of a well-marked anal lobe to the hind-wing suggested the *Rapala* group of Lycænids, but a close examination of the veins shows that neither lobe nor tail is homologous in the two widely separated genera. In addition to the above I took a second *Caduga tytia*, Gray, the first having been netted 1000 feet higher. This blue-and-black Danaid is distinguished by having brown hind-wings. Time was however getting on and my "sais" was waiting with the pony by the little bridge, so I reluctantly mounted. I had not ridden far when I caught a glimpse of *Kallima inachis*, Bdv., flying by the roadside; flinging myself out of the saddle I was fortunate in netting the butterfly of all others that I had wished to see alive. It proved to be a fine female; I could not afford to risk waiting to see her settle, and alas! never saw another. A few minutes later my sais brought me a damaged *Euplœa* with a lovely purple gloss; seeing many about I foolishly did not keep it. These things happened close to the Tísta bridge, by which the road to Lhasa crosses the river, here only some 650 feet above the sea, so deeply are these Himalayan valleys cut down. Sad to say in a few minutes the winding of the road took me under the deep chill shadow of the mountain and the purple-glossed *Euplœas* and nearly all the other butterflies vanished for that day. A solitary *Neptis aceris*, Cr., together with a few *Ixias pyrene*, *Huphina nerissa* and *Lampides elpis*, were all that I saw; with them was a Nyctemerid day-flying moth, *Trypheromera plagifera*, Wk.

The rest-house at Riang was reached too late for any more collecting, and I had to content myself with watching the long trains of Colonel Younghusband's bullock wagons painfully dragging loads of compressed hay for the Tibetan

expedition. Alas for the once fair road, now a foot deep in white dust!

December 19th. *From Riang by way of Mongpu and Sareil back to Darjiling.* This was such a long march that little time could be given to collecting, moreover many hours were spent passing along a beautiful forest track in the deep afternoon shadow of the mountain. At the start, close to the river, the silvery-white *Acropteris vagata*, Moore, was conspicuously spread out upon a leaf, this was the only Uraniid that I met with. Near Mongpu, at about 3000 feet, *Ergolis merione* was very common about *Ricinus*, the castor-oil plant, upon which its larva feeds. A little higher up I came across *Ticherra acte*, Moore, a Lycænid with very long tails that wave with the wind; it has a swift jerky flight. The hind-wing of this species is much plaited but the anal lobe is rudimentary.

Other captures were *Huphina nerissa*, a male; *Ganoris canidia*, a female with all the hind margin of the hind-wing gone; *Tachyris hippo*, Cr., a male; *Arhopala rama*, Koll.; *Neptis astola*, Moore; *Ilerda epicles*, Godart, with all the hinder part of the secondary apparently bitten off by a lizard; *Cirrochroa aoris*, Dbl., which I had seen at Pashók on the previous day; *Lethe rohria*, very like *P. ægeria* in its habits and liking for partial shade; and *Argynnis niphe*, this last in the cinchona plantation at about 3600 feet. A large white butterfly, bright yellow underneath, fluttering at the sweet white flower of the cinchona led me to dismount, and it was well that I did so, for it turned out to be *Prioneris thestylis*, Dbl., and fortunately a female, which must be very much the less common sex, at any rate the Hope Collection contained no female of the genus.

The next day, December 20th, I rode down to the Ranjit River, the boundary of Sikkim, *the* great Papilio country. Distance however reduced my actual collecting to less than four hours.

At about 3000 feet I took two of the Erycinid *Zemeros flegyas*, also *Symbrenthia hyppoclus*. The chief collecting-ground was near the suspension bridge leading into Independent Sikkim, closed this year to all Europeans, including entomologists, on account of the Tibetan difficulty. It was trying to one's European temper to be stopped by a coloured policeman, while natives passed freely over!

Here, some 8000 feet above the sea, the first thing that I happened upon was *Limnas chrysippus* in extreme

abundance in a very limited locality, it was in fact decidedly gregarious. By the way, pinching and cyanide are both but very imperfect ways of slaying these tough-skinned Danaids.

Elymnias undularis, both sexes, was common, but I did not see any *L. genutia* for its female to mimic; although the under-side of this butterfly is "leaf-like," it is, as a fact, usually conspicuous when settled.

I caught distant glimpses of two Papilios and I missed my first *Hebomoia*, in fact the things that I missed that day would have made quite a good collection!

The following were all common: *Huphina nadina* and *H. nerissa*, both males; *Ixias pyrene*, large; *Neptis accris*, Cr.; *Precis iphita*, spreading out like a *Eupithecia* when settled; *Symbrenthia hyppoclus*, and *Lampides celeno*, Cr., while *Terias hecabe* was very abundant and large.

Other things taken were *Yphthima marshalli* and *Mycalesis runeka*, Moore, this last a very dingy species. In marked contrast was *Jamides bochus*, Cr., the male iridescent dark-blue above, quite gem-like, beneath dull grey with a metallic ocellus at the anal angle of the hind-wing; the female comparatively dull in colour.

For some reason I that day missed a larger proportion than usual but managed to catch the following:—*Prioneris thestylis*, a male; *Cirrochroa aoris*, looking on the wing like a big *Argynnis*, but settling with wings half-expanded, several seen, but only one netted; a *Charaxes athamas* taken on a flower was the only individual of the genus that I got in all my travels. Another specimen of this very distinct and beautiful species was soon after seen feeding upon human ordure! Fear of fouling my net prevented me from striking down upon it, and it suddenly darted up, went twice round with a swift jerky flight and then disappeared. Mr. Möller had indeed told me that *Charaxes* was a very foul feeder.

The elegant day-flying moth *Trypheromera plagifera*, Walk., must be added to my list, as well as the little Geometer *Psilocambogia memorata*, Walk., which I found dead, caught and set out upon a burr (of some composite flower). Lastly a beetle, *Mimela horsfieldi*, Hope, of brilliant green with coppery tinge.

The extraordinary abundance of dragon-flies of many kinds at the Ranjit River was remarkable, yet I did not once see a butterfly attacked by any of them.

I left Darjiling on December 22nd, with much regret, and a strong desire to return at a better time of the year. On the way down, at about 4000 feet, *Ixias pyrene* was common, while close to Tindaria station, at about 2900 feet, I netted from the train a pale Blue with a whitish patch on each wing, *Cyaniris dilectus,* Moore, as well as another Blue, *Cyaniris ladon,* Cr., form *pseudargiolus,* Boisd., and an Acidaliid, *Idæa remotata,* Guen.

At Tindaria I left the train and walked down to Sukna. The following things were met with: (1) At altitudes of from 2800 feet to 2000 feet:—

The Erycinid, *Zemeros flegyas,* Cram., almost abundant, but rather worn; *Mycalesis indistans,* Moore; *Precis lemonias,* a small specimen in fine condition, also large ones worn [this and *P. iphita* were the only species of the genus met with in the Darjiling district]; single examples of *Neptis aceris, N. astola* and *N. varmona*; *Symbrenthia hyppoclus,* common; *Lampides celeno,* Cr., form *alexis,* Stoll., also common; *Ganoris canidia,* a female; *Huphina nadina,* a male, about 3000 feet; *H. nerissa,* a male, about 2500 feet; *Tachyris hippo,* a very fine female; *Terias hecabe,* abundant, two males, one of them dwarfed, were of the variety without the "dog's head."

(2) At altitudes of 2000 feet to 1500 feet:—Here I took *Catopsilia pyranthe,* a male; *Yphthima marshalli,* two; *Huphina nerissa,* worn males were common; *Precis lemonias,* several; *Terias libythea,* common; and the Blue, *Zizera otis,* Fab.

At about 3.30 p.m., I watched a fine specimen of *Papilio aristolochiæ* flying very slowly about herbage, apparently seeking for a resting-place for the night, just as I had seen *P. pammon* doing at Kháirna on November 18th; near the same place I missed two specimens of a black-and-white Danaid.

(3) A little way above Sukna, perhaps at about 700 feet above sea-level *Orsotriana* [*Mycalesis*] *runeka,* Moore, was in the greatest abundance in a deeply-shaded wood; this, a typical shade-lover, is sluggish but is on the move later than most things (for it was just before sundown), but when kicked up from ferns or other low herbage it did not fly more than two or three yards. It varies greatly in the pale streak on the under-side which may be white and very conspicuous or almost obsolete. One specimen exhibits a well-marked bite on the hind margin of both hind-wings

above the anal angle, the injuries on both sides corresponding closely.

It was dark when I reached Sukna station, 500 feet above sea-level, and fireflies, *Luciola* sp., were flitting about on all sides. A "flare" lighted just before the arrival of the train attracted many moths, of which I secured a large sharp-winged transparent Pyrale, *Cydalima conchylalis*, Guen.; and the Noctua, *Prodenia littoralis*, Bdv. In the train, immediately after starting I bottled a strange-looking ♂ winged ant, *Dorylus juvenculus*, Shuck.

Thus closed my short Darjiling campaign, and leaving behind with much regret the awe-inspiring Himálaya, we steamed away into the darkness over the monotonous plain of Bengal.

Bankápúr, lat. 25° 30′ N., alt. c. 250 ft.

December 22nd, 1903—January 3rd, 1904.

In absolute contrast to Darjiling, Bankápúr, the civil station of the great city of Patna, is situated on the level, monotonous, and highly-cultivated plain of the Ganges, affording little harbour for butterflies, so that a fortnight's stay with old friends at the hospitable parsonage yielded small entomological results.

In spite of these unpromising surroundings, *Limnas chrysippus* was common, and in company with it *Hypolimnas misippus*, of which I saw several males and secured one female, which latter so closely mimics the former species that even the small white spots on the thorax and head are reproduced!

Of *Tirumala limniace* I saw a solitary example, of *Crastia core*, two; but the other very common Danaid, *Limnas genutia*, was abundant in a mango orchard, and distinctly gregarious in its habits. It has rather an unpleasant scent, but whether or no it is confined to one sex I regret that I failed to notice.

The Satyrids were represented by a solitary *Mycalesis perseus*; the Swallow-tails by *Papilio pammon*, worn, *P. aristolochiæ*, and *P. erithonius*, the last a flower-loving species. *Precis* was represented by four species: *almana*, one of them with large pieces, in part corresponding, bitten out of each hind-wing; *œnone*, one; *lemonias*, several; and *orithyia*, several, the latter all small. Single specimens of the common and generally distributed *Atella phalanta* and

Ergolis merione were seen in gardens. A fine *Limenitis procris* was taken sipping "toddy" from a palm; I missed him at the first shot, but he foolishly returned to his fatal liquor.

Of *Catopsilia pyranthe* I took two males and a female. I held one of the former fluttering beneath my nostrils, when it gave out a strong scent that instantly brought *greenhouses* to my mind, then my own greenhouse, then *Polianthes tuberosa* (barbarously termed by nurserymen "tuberose"), and lastly jasmine. I do not think that I ever smelt so distinct a scent in a butterfly, always excepting the male of *Ganoris napi.* The other male *pyranthe* I held under my nose while I stroked the "feather-tufts" of the hind-wing; this at once elicited the odour of jasmine, further confirming the observation of Wood-Mason.

Two males of *Huphina nerissa* bear the following notes: "Scented, not like *napi,* more like *rapæ,*" and "this specimen had a scent like *P. rapæ,* i. e., of the sweet-briar type." Again a *female* of *Delias eucharis* (which was common) bears the note, "has a scent much like *rapæ,*" and the specimen appears to have been wilfully rubbed. My observations on butterflies in England show that in some cases *females* have a scent, but not like, or as strong as the males. My strong impression is that the *male* of *D. eucharis* has the *rapæ,* or sweet-briar scent.

The three species of *Terias,* viz. *hecabe, libythea,* and *læta,* were all common; one of the *læta* appears to have been bitten by a bird.

Nychitona xiphia was not uncommon, and several *Ixias marianne* were seen. *Chilades varunana,* Moore (according to De Nicéville the wet-season form of *C. laius,* Cr.), was common about irrigated flower-beds, indeed Blues are wonderfully fond of water. The only butterfly seen at Bankápúr that was at all out of the common, besides *Limenitis procris,* was the large grey Lycænid *Virachola isocrates,* Fab., of which I took one at flowers in the Commissioner's garden. I noted that its hind-wings were much folded posterior to the tails, the convexities of the folds being towards the upper-surface. These foldings of the wings are not well seen in set specimens.

Although Bankápúr is far from being a good locality, it will give some idea of the abundance of butterflies in India when I say that in mid-winter, December 24th, I took in a suburban garden within three-quarters of an hour no less

than ten species, some of them represented by numerous individuals.

Buddha Gáya, lat. 24° 42′ N., alt. c. 500 ft.

December 30th and 31st, 1903.

The vicinity of the shrine and its sacred Bo tree was not productive. All the butterflies that I saw there were one *Terias libythea*, a number of *Huphina nerissa* (the male yielding a distinct, but not strong, flowery scent), together with a lot of the Lycænid *Zizera karsandra*, Moore.

The next day, on a steep hill of red trap rock overlooking the town, I saw for the first time the Acræid *Telchinia violæ*, reminding one on the wing of *Argynnis euphrosyne*; it was locally abundant and gregarious, its tone of colouring harmonizing with the red igneous rock. On the same hill were two or three *Precis œnone* and several small *P. orithyia*, while *Zizera otis*, Fab., was abundant.

In the course of this walk I noticed a Fakir, or religious mendicant ascetic, watching my operations with evident suspicion, probably owing to the reverence in which some of these folk hold all animal life. Presently a small native boy threw a stone at a squirrel. I thought better of the Fakir when he cursed the boy so fiercely that he fled in terror as fast as the squirrel, while I rolled up my umbrella-net and passed on, trying to elude observation!

Mozufferpúr, lat. 28° 8′ N., alt. c. 300 ft.

On a flying visit, January 2nd, 1904, to this place, nearly north of Bankápúr, I took in my host's garden two *Zizera otis*, Fab., and one *Zizera maha*, Koll.

Allahabád, lat. 25° 30′ N., alt. 370 ft.

Here on January 4th I saw a few of the very commonest Indian butterflies in the public garden. The railway carriage before leaving in the evening produced a grasshopper, *Atractomorpha* (*Perena*) sp., and *Prodenia littoralis*, a Noctua that came to light. This last proved tenacious of life, it laid a number of eggs in its paper which hatched on the voyage, the young larvæ perishing miserably.

Jhánsi, lat. 25° 30′ N., alt. c. 750 ft.

January 5th—13th, also 21st, 1904.

Situated on a sandy plain, broken by precipitous ridges of igneous rock, Jhánsi, something like 750 ft. above the sea, is characterized by dryness, heat, and sparsity of cover.

A couple of *Papilio aristolochiæ* taken at flowers near the lake were the sole representatives of their family.

Several *Belenois mesentina* were taken, but it was scarcely common; the male had a distinct but faint, sweet scent; on the ridge of Retribution Hill (where Sir Hugh Rose in 1858 slew 2000 mutineers), I took a female *B. mesentina* in which the hind-margins of the secondaries had been symmetrically broken off, probably by the bite of a lizard. Of three specimens of *Terias hecabe*, one, a small female, was of the variety without the "dog's head" notch. Of *T. libythea* a single specimen was taken, but *T. læta* was common and of gregarious habits. *Teracolus etrida* was locally rather common, especially the female. On the other hand, the male of *Ixias marianne* was rather common.

Two *Atella phalanta* were taken; the only *Precis* noted was *orithyia*, and that very dwarfed, one measuring only 1·4 inches across the wings.

Telchinia violæ was abundant at the foot of Retribution Hill, and scattered specimens occurred elsewhere. This insect, like the Danaids, has a tough skin which enables it to resist pinching, and doubtless makes it indigestible. When injured a yellow juice exudes; a minute drop of this placed on the tongue tasted somewhat bitter and disagreeable, but the flavour was by no means strong.

The Jhánsi Lycænids were fairly numerous, but not very brilliant, the most striking was *Chilades putli*, Koll., actually smaller and darker than our *alsus*; other species were *Chilades laius*, Cr., which appears to have been common, but of which I unfortunately took but one specimen, and *Catochrysops contracta*, Butl., of which I took two; *Tarucus theophrastus*, Fab., of which the two sexes are, on the upper surface at least, very different, was common, but of *T. telicanus*, Lang, I only secured one of each sex, though noting it as common. Blues are very abundant in India, but they are very much alike, so that being ignorant of the distinctions between allied species, one was but too apt to neglect them while in the eager

pursuit of larger game. For these reasons too much weight should not be attached to the observation that such and such a species was common or abundant, but the qualification, "or something superficially like it," should be added.

Two moths came to light, an Agrotid *Euxoa spinifera*, Hübn., and the *Macaria*-like *Semiothisa frugaliata*, Guen. I also took a brown beetle, *Bolboceras quadridens*, Fab.

After prolonged drought there was a heavy rainstorm at Jhánsi on January 14th, and there was slight rain at Gwálior on the 16th and 17th. With the exception of a *very* few days when there had been clouds and occasionally a *few drops* of rain, there had been almost uninterrupted sunshine for three months, *i. e.* since October 8th. On January 20th, writing to Dr. Dixey, I said, "There has been a very cold 'wave' in Northern India with a few showers of rain, but scarcely enough of the latter to affect either vegetation or insects." On January 23rd there was gentle rain at Jhánsi lasting several hours.

On January 21st I had another day's collecting at Jhánsi, but the species taken were not such as to show any effect in the way of change of type due to the rain, even if such change had been possible. The insects met with were *B. mesentina*, *I. marianne*, *T. etrida*, *A. phalanta*, and *Tarucus theophrastus*.

Orcha.

On January 9th I had an hour's collecting in this interesting deserted city, some eight miles to the east of Jhánsi, and took or saw *Limnas genutia*, *Precis lemonias*, *P. œnone*, and *P. orithyia* (this last in abundance), *Atella phalanta*, an *Ixias*, *Teracolus etrida*, a *Terias*, and several female *Belenois mesentina*. Monkeys were almost as common as butterflies among the ruined tombs.

Burwa Ságar.

On January 14th I got a couple of hours' collecting in the neighbourhood of the interesting and romantically-situated old castle of this name, which lies some twelve miles to the east of Jhánsi.

Here I observed in two specimens of *Limnas chrysippus* (of which certainly one was a male) a distinct cockroach-like odour, sufficiently strong to be perceptible when the

insect was fluttering in the net. Of *Catopsilia pyranthe* I took a female of the *gnoma* form; of *Terias hecabe* a male, the variety without the "dog's head" mark. *T. læta* was quite abundant. Two specimens of *Huphina nerissa* were taken, one worn, the other a dwarf. The male of *Belenois mesentina* was common, in two specimens I detected a sweet scent like that of *P. rapæ*, but more or less faint. A *Polyommatus bæticus* completes the list.

Ágra, lat. 27° N., alt. 550 ft.

January 25th and 26th, 1904.

At the sight-seeing centre of India there was but little time or opportunity for entomology. In the fair gardens of the Taj Mahal *Limnas chrysippus* was abundant, three or four *Papilio aristolochiæ* haunted the brilliant orange-coloured flowers of *Bignonia venusta*, and a few *Belenois mesentina* were flying around. In the Government garden close by I also saw the *Belenois*, together with *Huphina nerissa*, *Precis orithyia*, and *P. lemonias*, *Limnas chrysippus*, and *L. genutia*, also a *Teracolus*, and some Blues which escaped capture.

Fathipur Sikri.

January 28th and 29th, 1904.

At the abandoned capital of Akbar the Great, the Pompeii of India, some twenty-two miles west of Agra, those ruin-frequenting butterflies, *Belenois mesentina* and *Teracolus etrida*, were both common, but all appeared to be males. The *Belenois* had a faint, sweet, flowery scent, which did not appear to me to be quite like that of any other insect.

I also took one *Teracolus puellaris*, a female, and a most ferocious hornet, *Eumenes dimidiatipennis*, Sauss., a ♀.

Jáipur, lat. 27° N., alt. 1600 ft.

February 2nd, 1904.

The fine public gardens of the enlightened Máharájah are too well kept to be a good collecting-ground. *Terias læta* was however to be had there [as well as at the deserted capital Ambér, a few miles to the north and on higher ground]; those taken were males; a very small

Limnas chrysippus seemed to bear evidence of the prolonged drought. The genus *Papilio* was represented by *aristolochiæ*, and the Chrysid *Stilbum splendidum*, Fab., did its best to gratify the Rájpúts' love of brilliant colour.

Ajmir, lat. 26° 30′ N., alt. c. 1800 ft.

February 4th and 5th, 1904.

The most notable capture here was *Teracolus fausta*, Oliv., of which I only got one male, a poor specimen, missing two others; it has a very distinct orange look on the wing, and I feel sure that I saw one on January 22nd at Pálipahári, the artillery camp near Jhánsi.

Of *T. etrida* I took two males, one of them had lost the apex of the left fore-wing and all its hind-margin, as well as the apex of the left hind-wing. This is notable as possibly being an attack on a "direction mark."

I saw several battered *Precis œnone*. The smaller fry were represented by a very neat little chequered Skipper, *Hesperia galba*, Fab. The emerald-like *Stilbum splendidum* again turned up.

On Taragarh, the precipitous hill that overtops the city by perhaps 500 ft., I got only *Belenois mesentina*, *Terias læta*, and the long-waisted ♀ wasp, *Eumenes dimidiatipennis*, Sauss.

Mt. Ábu, lat. 24° 30′ N., alt. of civil and military station c. 4100 ft.

February 6th—8th, 1904.

Insects were extremely scarce upon the sacred Jaina mountain. The commonest butterfly was *Terias læta*; it was abundant up to 4500 ft., and the only representative of the genus seen. These, together with *Belenois mesentina*, *Huphina nerissa*, a few *Precis lemonias*, and a couple of *tages*-like Skippers (which I missed upon rocks at about 4400 ft), were the only butterflies that I saw on the elevated plateau. One moth, the very widely-distributed Crambus, *Eromene ocellea*, Haw., came to light.

At lower elevations, on the fine road up from the plain, the following were met with: at about 3000 ft., *Belenois mesentina*, *Taracus telicanus*, and *Polyommatus bæticus*, the last as usual in poor condition. From 3500 ft. down to

2500 ft. a few *Yphthima inica*, Hew., were seen, and at about the last-named elevation, among the rocks of a nearly dry water-course, I saw two specimens of the beautiful Nymphalid, *Symphædra thyelia*, Fab., but only secured one. It has the habits of a *Vanessa*; unfortunately time was pressing, or I might probably have taken more.

Bombay, lat. 19° N., near sea-level.

February 10th, 1904.

In an hour's visit to the Victoria Gardens, where there were a fair number of insects, I got *Papilio erithonius*, *P. aristolochiæ*, *Neptis varmona*, and *Nepheronia hippia*, a female, the last named mimicking *Tirumala*.

On February 15th I was much interested in watching the movements of a solitary butterfly in the small public garden of the University, in the heart of the city. It appeared to be a large *Catopsilia*, possibly the *catilla* form of *pomona*, but at any rate of a general greenish-yellow colour; when disturbed it invariably settled in one or other of several small shrubs with yellow leaves, when it would vanish quite suddenly. It was only after several attempts that I succeeded in getting a glimpse of it when settled, so strong was the protective resemblance.

Bijápúr, lat. 17° N., alt. c. 1500 ft.

February 16th and 17th, 1904.

This was further south than I had yet collected, but the scanty vegetation among the ruins seemed too parched to yield very much. The most prevalent genera here, as at so many places where thorns, burrs, rocks and ruins predominated, were *Belenois* and *Teracolus*, the last a genus which, though beautiful in the cabinet, is not effective on the wing.

Teracolus etrida was abundant, the males appearing to be about twice as numerous as the females; they varied greatly in size, so much so that among the males the largest had nearly double the alar expansion of the smallest. Of *T. dulcis* I took one female, and of *T. amatus*, var. *modestus*, two males.

The only *Terias* seen was *læta*. *Belenois mesentina* was abundant; a slight sweet scent was detected in one specimen.

Catochrysops strabo, Fab., was common, also *Polyommatus bæticus*, one specimen having lost two-thirds of each hind-wing, presumably the work of some enemy; of *Zizera karsandra*, Moore, I took one.

At night several moths came to light, viz. the Ocneriad, *Enome detersa*, Walk., the Geometers, *Tephrinia disputaria*, Guen., and *Idæa fibulata?* Guen. (worn), and the very widely-distributed *Etiella zinckenella*, Treit.

A ferocious-looking spider, a *Solpuga*, shared the Dák Bungla with us.

Anantápúr, lat. 14° 30′ N., alt. c. 1500 ft.

February 18th—23rd, 1904.

This small civil station, situated on an irrigated though elevated plain devoted to the growing of cotton and rice, is typical of Southern India.

A very hot walk to some small granite hills on the other side of the lake produced little beside two males of *Ixias marianne*, and a solitary *Teracolus eucharis*; the hills seemed too hot, dry, and parched to harbour butterflies.

About the trees along the dam, or "bándh," were a few *Hypolimnas misippus*, males, and abundance of *Papilio aristolochiæ*.

In the cotton fields by the river *Hypanis* [*Biblia*] *ilithyia*, Dru., was to be got, but not plentifully.

The best collecting-ground was a very weedy nursery garden and orchard. Here I one day had the advantage of the assistance of my host, Mr. Edwin Scott, I.C.S., whose keen appreciation of scents helped me greatly. *Limnas chrysippus* was abundant; of its scent Mr. Scott's first impression was "some sort of dung," then "a zoo"; later he said "possibly like a cockroach, but more like a musk-rat." The scent is, I think, general, but is perhaps stronger when the scent sacs on the hind-wings are opened: a fact that I also observed at Calcutta.

Crastia core was common and gregarious, frequenting a special mango-tree. When he smelt this insect Mr. Scott at once cried out "acetylene," adding that he would like to put a lighted match to it to see whether it would burn! Subsequent observations on the butterfly and the gas convinced me of the accuracy of his comparison. The genital organs appear to exude the scent, probably the long tufts appended to them.

At this place I confirmed in two specimens of *Catopsilia pyranthe* the jasmine odour connected with the "scent tufts" of the male, but did not find it as strong as in specimens of the same species examined at Bankápúr six weeks before. Mr. Scott agreed to the comparison with jasmine, but thought the scent was perhaps even more like that of *Polianthes tuberosa.*

I also examined two males of *Tirumala limniace* for scent, but was unable to elicit any from the prominent sacs on the under-side of the hind-wings, although I suspected some to be emitted by the genital tufts.

Papilio erithonius was frequently met with, and *P. aristolochiæ* was common, but I only took a single *P. pammon.* Although the male of *Hypolimnas misippus* was fairly common, I only saw one worn female; this was of the very marked variety *inaria,* Cramer, in which the white marks near the apex of the fore-wing are entirely wanting, and the black tip is reduced to a narrow border, so that it closely mimics *L. chrysippus,* var. *dorippus,* Klug., a form that is very rare in India. I several times saw the male *H. misippus* reconnoitring *L. chrysippus* as if in doubt as to its identity!

Of *Precis œnone* I took but one, of *P. almana* two, but *P. lemonias* was common. Of the following species I took mostly single examples:—*Limnas genutia*; *Ergolis ariadne*; *Neptis varmona*; *Polyommatus bæticus*; *Lampides celeno*, Cr., form *conferanda,* Butl.; *Catochrysops hapalina,* Butl., two; *C. strabo,* Fab.; *Zizera otis,* var. *indica,* Murray, two; and the Skipper, *Suastus gremius,* Fab.

Of *Melanitis ismene* I took but a small fraction, for one seldom sees a butterfly so battered, yet even this fraction was found in the shade. In marked contrast are the habits of *Telchinia violæ,* since it haunts the most sun-scorched places; it was not uncommon at Anantápúr, but if gregarious, as elsewhere, then I did not hit upon its head-quarters.

I took one *Terias libythea,* and saw several *T. hecabe,* though it was but moderately common.

Hovering at flowers I two or three times saw, and once caught, *Cephanodes hylas,* L., an insect very like *Sesia bombyliformis,* Esp. There were also flying in the sun *Deiopeia pulchella* and *Trigonodes hyppasia,* Cr., a Noctua very like *Hydrelia unca,* L., which reminded me of Headington and old Oxford days.

Out of the grass I kicked up *Tephrina catalaunaria*, Guen., a pretty little Macariid Geometer *Semiothisa subalbitaria*, Swinhoe, and *Sterrha paullula*, Swinhoe. The common dragon-fly, *Orthetrum sabina*, Dru., and a bug, *Eysarcocoris guttigera*, Thunb., completed the tenants of the garden.

A number of things came to light, viz.:—*Deiopeia pulchella*, the Ocneriad, *Enome detersa*, Walk., a Noctua, *Ericeia inangulata*, Guen., a Pyrale, *Schœnobius bipunctifera*, Walk., and a tiny Quadrifid Noctua *Raparna lactea*, Swinhoe, as well as two bugs, *Acanthaspis apicata*, Dist., and *Dieuches uniguttatus*, Thunb., the former apparently a scarce insect since the national collection contains the type only. There was in addition to these a small ochreous narrow-winged Geometer to which I have not been able to assign a name, and an ichneumon, *Henicospilus*, sp. In fact one evening swarms of insects came to light, including many mosquitos, but these appeared to be all *Culex*, fortunately no *Anopheles*.

Bangalúr, lat. 13° N., alt. 3100 ft.

February 23rd, 1904.

The change of trains at this large military station gave me an hour or two's collecting in the extensive public gardens. There was rather a high wind which was against a good day, but the afternoon proved interesting since it gave me the first glimpse at the "Ceylon" fauna. Here I saw for the first time that very striking black, white, and orange Lycænid, *Talicada nyseus*, Guér., as well as the huge and magnificent *Papilio polymnestor*, Cram. [*parinda*, Moore], a truly gorgeous monster in which a pale lilac is the prevailing colour trimmed with black.

The only other things noted were more ordinary, to wit *Catopsilia pomona*, a female, *Crastia core*, several *Telchinia violæ*, *Nychitona xiphia*, an abundance of *Neptis varmona*, and one *Neptis jumba*, Moore.

The Nilgiris, lat. 11° N.

February 24th—March 3rd, 1904.

The Nilgiris, or Blue Mountains, rising abruptly from the plain, itself nearly 2000 ft. above the sea, form a

rolling table-land with an average altitude of from 6500 ft. to 7500 ft. This plateau consists for the most part of grassy downs with here and there "sholas," or thickets of mixed growth, very beautiful at this time of the year owing to the red colour of the young leaves of the preponderant tree. Unfortunately, alike for the entomologist and the artist, these "sholas" have been largely cut down to make way for the extensive Government plantations of eucalyptus, which are by comparison dreary and monotonous.

On the way up the cog-wheel railway I saw on the side of the cutting two beautiful blue-green Papilios, which may have been either *P. telephus*, Feld., or *P. teredon*, Feld. At about 4500 ft. I netted a *Neptis varmona* from the train in motion.

It was evidently too early in the year to get many butterflies at Útakamand, the elevation making the nights cool, so it was necessary to seek out sheltered flowery banks facing south, or preferably south-east. In two such spots within a very circumscribed area *Talicada nyseus* was common; a single example also occurred [along with the inevitable *Pyrameis cardui*] on the grassy top of an isolated and exposed peak of about 8000 ft. This Lycænid is quite typical of "South India and Ceylon"; it is a conspicuous insect on the wing, its tricolour of black, white and orange-red, which should delight German entomologists, making it look larger than it really is.

Terias hecabe was rather common, but worn. A female *Lycæna bætica* and several *Pyrameis indica* were also old friends, and the same applies to two or three *Papilio aristolochiæ* seen at flowers in the hotel garden, the latter a good deal the worse for wear.

A few *Yphthima chenui*, Guér., occurred at about 7800 ft., the only *Satyrid* I met with at Útakamand. *Ganoris canidia* flew up to 8000 ft.; a male had a distinct smell like that of our *Pieris rapæ.* I submitted the living butterfly to my daughter and her lady friend, who both noticed the scent, though unable to describe it. When mignonette was suggested for comparison they both said "No"; but when sweet-briar was mentioned they said it was like that, my daughter speaking the more confidently of the two.

At about 7400 ft. I took a female *Catophaga paulina*, and also a fine female of *Hiposcritia narendra* [Moore], quite a

Ceylon species. The specimen is labelled "flies fast: rather common from 7400 ft. to 8400 ft." It is but too evident that I had not recognized that I was catching anything out of the common, and it is more than probable that I confounded the females of *Catophaga* and *Tachyris* with *Hiposcritia*, so that I am not by any means disposed to trust the statement that *H. narendra* was common then and there. One necessary consequence of my complete ignorance of the Indian fauna was that I did not know what was most worth catching. These white butterflies are as a rule by no means easy to catch and were often in bad condition, but in each locality I used to endeavour to secure one or two good samples. Doubtless the *Hiposcritia* passed for a very fine *Tachyris*.

Amongst herbage *Mecyna polygonalis*, Hb., was often kicked up, having much the habits and appearance of my old Bermuda and Mortehoe friend *Stenopteryx hybridalis*, Hubn. (*Nomophora noctuella*, Schiff.), which too was fairly common in exposed situations at about 8000 ft.; at a similar elevation a single example of the Danaid *Badacara nilgiriensis*, Moore, was taken.

Above the Botanic Garden on the road to Dodabetta, at about 8000 ft., I several times saw, but missed, *Vanessa charonia*, Dru., a butterfly that looks dingy in the cabinet, but on the wing looks much brighter and bluer than would be expected. It is sometimes called the Blue Admiral (completing the trio), though in truth it is much more like a tortoise-shell. *Argynnis niphe* was common at the higher elevations, and in exposed situations up to 8500 ft., reminding one of *A. aglaia*, L. It flew up and down the roads, returning again and again to the same spot.

The commonest and most characteristic butterfly of Útakamand was the pretty little *Colias nilgiriensis*, Feld., which was seen coursing over the grassy downs from 7300—8600 ft. Its flight is moderately fast, but quite close to the ground. It was somewhat startling, but in a way refreshing, to come across this Arctic survival so far within the tropics, associated moreover with species characteristic of Ceylon. As it was especially abundant in the hotel garden I took the opportunity of examining five males for scent; in two cases I suspected the existence of a slight scent, but in the remaining three the result was negative.

From Útakamand I moved to Konúr, which stands on the southern edge of the plateau, overlooking the plain.

It is at about 6500 ft. above sea-level, or 1000 ft. lower than Útakamand. At this elevation *Colias nilgiriensis* was not nearly so common as at the higher levels.

Worn *Pyrameis indica*, a few *Neptis varmona* and *Precis iphita* turned up here and there. Of a pair of *Terias hecabe* taken *in copulâ*, the male proved to be of "intermediate dry," the female of "pronounced dry" type. Opportunities of noting the pairing of the several forms occurred very rarely. Here I secured one specimen of *Yphthima ceylonica*, Hew., another foretaste of the great southern island. *Y. inica*, Hew., turned up at about 5800 ft., but at about 6500 ft., in a clearing in a wood, I found *Y. hübneri*, Moore, together with *Y. chenui*, Guér., and *Y. philomela*, Joh. There were swarms of these *Yphthimas* on that sunny bank, but as I did not distinguish the species at the time I cannot now say of what the bulk of them consisted. Some of the specimens have injuries to the wings, which from their shapes *may* have been inflicted by birds, but I attach little importance to them, especially as the injuries are unilateral, since the wings of *Yphthima* (and to a somewhat less degree of *Mycalesis* also) are so fragile that quite unbroken specimens are exceptional.

The genus *Papilio* was represented by a couple of *erithonius*. As usual *Argynnis niphe* showed a preference for lofty and bare places. On one occasion I watched a female of this species for some time under the impression that it was *Limnas chrysippus!* The resemblance on the wing is greater than might be supposed. *Vanessa charonia*, Dru., which had before eluded me so often, fell a victim at last; I secured two specimens on a shady road through a wood. It settles on rocks or walls, a habit that makes it hard to net, moreover it is shy and easily disturbed, though usually coming back again to its resting-place.

Stenopteryx hybridalis was common in grassy places, and I took the Boarmid *Bilactis inceptaria*, Walk., flying in the hotel garden at dusk.

It was tantalizing to be told by the hotel manager at Konúr of the immense number and variety of butterflies there in the summer. I was, however, fortunate in making the acquaintance of a dealer, named Solomon, a coloured man, who told me that at that time of the year it was no good collecting on the high ground, but for a consideration he agreed to show me a very good place

near the foot of the hills. Accordingly I went with him on March 2nd, and again alone on the following day. This involved travelling by an early goods-train to Kallár, the first station on the mountain railway above Mettupálaiyam, about 2000 ft. above the sea, but only 200 ft. to 300 ft. above the plain. Here, as in other parts of India, the best places for insects, at any rate in the winter season, are to be found in the belt of jungle at the foot of the hills, or in the woods on their lower slopes. But it is just in these places where the dreaded *Anopheles* is as abundant as the Rhopalocera, and the station-master at Kallár told me that entomologists always slept at Konúr and went up and down by train to avoid the nocturnal terrors of the deadly malaria—the tiny, innocent-looking *Anopheles!*

The collecting-ground was various, and included, besides bushy jungle with plenty of flowers near the station, large irrigated banana and betel-nut plantations as well as the bed of the river with its bordering woods.

The first thing to catch the eye was *Papilio hector*, L., and very magnificent he looked fluttering at the flowers of *Lantana* in his crimson-and-black suit set off with white. This is indeed one of the most striking butterflies that I met with in my travels, with its wings expanding four inches and upwards. It proved to be distinctly common, but one does not get within reach of every *Papilio* that one sees, nor indeed does one succeed in netting all that are struck at. *P. hector* was accompanied by plenty of *P. pammon* and a few *P. aristolochiæ.* One of the *P. hector* brought home is remarkable for the fact that the whole of the tips and half the hind-margins of both hind-wings have apparently been bitten off, almost absolutely symmetrically, by some foe. If the red spots on the under-side be really "warning marks" this is the more noteworthy.

A boggy, but sunny, corner of an irrigated banana-garden produced single specimens of the fine Skippers *Tagiades atticus,* Fab. [? = *T. menaka,* Moore] and *Tagiades distans,* Moore.

This same garden and the adjoining plantations of betel-palm (*Areca catechu*) yielded a few *Melanitis ismene,* a fair number of *Mycalesis perseus,* Fab., as well as *Yphthima marshalli* and *Y. philomela,* Joh. [= *baldus,* Fab.]; there was also abundance of the pretty and very distinct *Yphthima ceylonica,* Hew., with its silvery-white

hind-wings, which tried, not without occasional success, to pass itself off as a Blue. A few hasty observations on this species when at rest failed to detect any such "list" as is common in many members of the family.

I sent home two specimens of *Mycalesis perseus*, one an ordinary example of the dry-season form in which the ocelli are indicated by faint dark dots, the other (unfortunately very tattered) in which the full complement of ocelli on the under-surface is indicated by conspicuous chalky-white spots of varying sizes, to wit, two large and one small on the primaries and two large and five small on the secondaries. Three of these spots are faintly visible on the upper-surface. There are no rings and no pupils to the spots. It would appear to be a unique aberration of the dry-season form. In the shade along with the above Satyrids was the inevitable *Nychitona xiphia* and a solitary male *Elymnias undularis*.

A weedy neglected field near the river yielded besides *Limnas chrysippus* and *Atella phalanta* plenty of the "orange-tip" *Ixias marianne*, as well as a smaller number of the more gaudy *Ixias pyrene*. One proved to be a worn specimen of the female lacking the orange tip, a distinct and well-marked variety; another was of the racial form *cingalensis*, Moore. The "whites" *Huphina nerissa* and *Catophaga paulina* were in plenty. A single *Catopsilia pomona* was netted, a somewhat papery-looking insect, especially on the under-side, also several *C. pyranthe* of the "transitional *Gnoma*" form. In one of the latter (a male) I detected a faint scent, but less like that of jasmine than in the *Catopsilias* examined at Anantápúr. In the same field *Telchinia violæ* was abundant, while *Ergolis ariadne* was, as usual, common among *Ricinus*.

But all this time Solomon was most anxious to get me down to the river. This is a rapidly-flowing stream, occupying perhaps half its bed, and having on either bank sloping woods of mixed growth. Solomon sought out a place where a tiny tributary emerging from a rushy swamp trickled over the damp sand. He forthwith stuck into the wet sand a foot or so from the rill and well clear of the herbage, three or four large butterflies of which he had netted worn or broken specimens; then he stood by to watch. Nothing much happened, for unfortunately clouds had come up and the afternoon was only partly sunny, whereas to get many things at water, whether decoys be

used or not, it needs, as Solomon put it, to be "plenty hot." It was indeed hot enough for most Europeans, but not up to the exacting butterfly standard. However, next day the conditions were more favourable, and I found near what was left of Solomon's decoys a number of "whites" and "orange-tips." Accordingly I put down a few more decoys and walked away. After spending some time in vain endeavours to catch the conspicuous *Hebomoia glaucippe*, L.—giant of orange-tips—which was careering wildly about in all directions, I returned to the decoy-place and sat down just within the reach of my six-feet net-stick. *Catophaga paulina* were there in abundance, but all males, mostly sitting quite close together, almost touching, with wings erect so that the "hook-tip" of the fore-wing was very conspicuous; in another cluster close by were from six to eight *Ixias marianne*.

It will perhaps give some idea of the numbers when I say that I quite easily netted five *C. paulina* in one swoop, and seven in another.

Then *Hebomoia glaucippe* came along, reconnoitred the position with great circumspection, and settled warily for a second or two, but darted swiftly off at the least movement on my part. Nevertheless, with care and patience, I managed to secure a couple of specimens. My old friend *Papilio erithonius* came next and soon settled down a short distance away from the "whites," he was shortly followed by another and yet another: they all settled close together, within a hand's-breadth, forming an exclusive community and continued to drink steadily. All at once a blue-green flash, and *Papilio telephus*, Feld., sailed close past me; again and again he came, and finally, looking askance at the vulgar assemblage of "whites" and "orange-tips," settled quite close to the *P. erithonius*, evidently preferring their more select company. This occurred several times. *P. telephus*, when settled with wings erect, displayed an unexpected beauty, for, in place of the ebony and emeralds on the upper-surface, it shows beneath nothing but sheeny mother-of-pearl picked out with tiny rubies. By patient watching and judicious swooping I secured three specimens, and, be it remembered, these were all I saw that day. So much for water; what share the decoys had in my success it is hard to say, but Mr. E. E. Green, of Peradeniya, told me that decoys were efficacious, and Mr. Denton, of Regent Street, says that he has used even paper decoys with success.

The congregation of butterflies at damp sand was observed by Bates on the banks of the Amazon in 1849. He noted that they were all males, mostly of the genus *Callidryas.** Indeed Sir J. D. Hooker had the year before noted butterflies sitting on damp sand "in thousands" in the Ranjit valley, Sikkim.†

Mr. E. André noted a similar thing in Venezuela in 1897, where the attraction was the foul mud of a farm-yard: the butterflies were chiefly *Callidryas*, with some *Heliconius*, *Papilio*, *Metamorpha* and *Cærois*. He says: "Each species tried to herd with its own kind," but he says nothing as to sexes. There is a capital photograph in his book of a group of *Callidryas.*‡

Doubtless this habit of butterflies is well known to all tropical collectors. I myself in Germany some 35 years ago, noted swarms of Blues at small puddles in the road—several species together, including, so far as I could see, *L. alsus*, *L. arion*, and *L. bætica*. A few days afterwards near the same place and similarly occupied I caught *Apatura iris* in my hat! This summer at Mortehoe, on the 1st of August, in the early afternoon, I saw 14 or 15 *G. napi* sitting close together on wet mud; they were all males.

A piece of waste ground adjoining the plantation of the singularly graceful *Areca* palms, covered with *Lantana* in full bloom, was crowded with butterflies such as *Crastia core* and *Narmada coreoides*, Moore, one or both of which (for I did not distinguish them when alive) was abundant; several *Neptis varmona*, and two or three *Nepheronia ceylonica*, Feld., another southern species. More striking than all these were the swarms of *Tirumala limniace*, a big and handsome black and bluish-white Danaid, which I found all over India but never saw elsewhere in anything like such numbers as on that mass of *Lantana*.

Other things that turned up in the course of the two days' collecting were *Tachyris hippo*, two; *Teracolus etrida*, one; *Hypolimnas bolina*, two males; *H. misippus*, one male; *Precis iphita*, common; *Caprona ransonnettii*, Feld., one; *Parnara mathias*, one; *Castalius rosimon*, and plenty of *Lampides celeno*, Cr., including the form *conferanda*, Butl.

Of the above the fine Skipper, *Caprona*, was seen to settle, in full sunshine, on the *under-side* of a leaf, with its

* "Naturalist on the Amazons," 1st edn., p. 249.

† "Himalayan Journals."

‡ "Naturalist in the Guianas," p. 142.

wings fully expanded like a Geometer. I do not ever remember seeing a butterfly do this before, but then we are perhaps wrong in calling Skippers butterflies. One of the *Lampides*, a female (?), was found settled close to the ground, with all its wings erect as usual and close together; it was however moving its hind-wings alternately, in a rhythmical manner, *in the plane of the wing*, about 10–15° forward and then back. No other specimen of the species was near it.

On the occasion of my first visit to Kallár, as we were walking back to the station, Solomon suddenly darted off like the wind, and I found that he was after a very large *Papilio* which he had caught sight of flying about a puddle in the road, some hundred and fifty yards off. He waited long and patiently until it settled to drink and then popped his net over it. It was *Papilio polymnestor* in splendid condition, black and French grey, 5½ inches in expanse! This haughty beauty was not kind to me at Kallár; many a time I caught a glimpse of her flying about in a supercilious sort of way, but she never gave me a chance of closer acquaintance. Solomon had the advantage of me in many ways, first and foremost in years, next in his keen sight, but he was also wily and skilful with his net. During the day he took among other things a specimen of *Papilio agamemnon*, L., a fine black-and-green fellow that I too had seen; also one of that grand diamond-beetle green butterfly *Papilio crino*, F., which I missed the next day at *Lantana* flowers, as I believe, through sheer excitement!

Trichinápali, lat. 10° 50′ N., alt. c. 400 ft. or less.

March 4th and 5th, 1904.

My collecting here was almost confined to the banks of an irrigation canal, where the genus *Papilio* was represented by *P. hector*, *P. pammon*, and *P. aristolochiæ*, of each of which I saw several.

Limnas chrysippus was common; in the male of *Tirumala limniace* I detected a very faint scent, suggesting old cigar-boxes.

Catopsilia pyranthe was rather common, the specimen preserved was of the intermediate form; I noted a scent in the male, but it was not so strong as in some of the Bankápúr specimens. Of *Delias eucharis* I took two

females, by far the less common sex, at all events in collections. Of *Huphina nerissa* I took one of each sex. *Terias hecabe* was abundant.

The most striking fact about the butterflies of Trichinápali was the predominance of the genus *Teracolus*; of these I met with three species: *T. eucharis* was in abundance, but I find my specimens comprise eight males to two females; of *T. etrida* I took two males; and I was greatly delighted to see here for the first time that truly exquisite little gem the crimson-tipped *T. danäe.* It proved to be rather common, and I secured two of each sex. It is one of the most "elegant flies" that I have ever seen alive.

Precis orithyia was common, the specimens small and brilliant; *P. lemonias* was in larger numbers than I met with anywhere else, in fact quite abundant; *Ergolis ariadne* was common; I netted a pair of *Hypanis ilithyia in copulâ*, one was of the "wet-season" form, the other "intermediate" tending to "wet." As usual *Telchinia violæ* was common.

I took here one specimen of that beautiful Lycænid with the under-side striped like a tiger, *Spindasis vulcanus.* This is one of the butterflies with an anal lobe to the secondaries, but unfortunately I had not an opportunity of observing it at rest. *Lampides celeno*, Cr., was common; some smaller and dingy Blues were abundant, *Zizera otis*, Fab., var. *indica*, Murray, and *Chilades varunana*, Moore, thought by De Nicéville to be the wet-season form of *C. laius.* I also took one specimen of a small bright golden Skipper, *Ampittia maro,* Fab.

Tanjúr, lat. 10° 47′ N., alt. 350 ft. or less.

March 6th, 1904.

The predominant genus of the plains of Southern Madras would appear to be *Teracolus*, which was represented in my envelopes from Tanjúr by a male *T. etrida*, a pair of *T. eucharis*, and five males and two females of my favourite crimson-tip, *T. danäe*, which was quite common.

Of *Catopsilia pyranthe* I took a dwarf male of the intermediate form. *Terias hecabe* was common, and I took a very large female [over 1·8 inches in expanse, it was

"dry"]. Single specimens of the following were sent home: *Nychitona xiphia*; *Papilio pammon*, male; *Limnas chrysippus*, female; *Castalius rosimon* and *Lampides celeno*, Cr., of the form *conferanda*. *Telchinia violæ* was common, one being of a fine red colour.

Mádura, lat. 9° 55′ N., alt. 600 ft.

March 7th, 1904.

This was about the least productive place that I visited. *Limnas chrysippus* was scarcely common. A male *Huphina nerissa* gave out the sweet-briar scent quite strongly. I saw several *Telchinia violæ* upon a railway bank. *Precis œnone* was fairly common, but *P. almana* was commoner here, about the irrigation ditches bordering meadows, than at any place I visited; they were of the "intermediate dry" form. *P. lemonias* was also abundant, some of them being very brightly coloured.

In a grove of young palms near the river a singular dragon-fly, *Libellula variegata*, Linn., was common; the tips of its wings are transparent and colourless, but the basal three-fifths of the primaries, and the basal five-sixths of the secondaries, are light-brown with a bold dark-brown pattern. I believe that I saw the same creature in the Kudsia Gardens at Delhi, flying near the tops of trees, and then, as in the present case, took it for a *Heliconius*-like butterfly, which it greatly resembles on the wing. As I did not know that any butterfly of that shape was found in India I was greatly excited at seeing it, and proportionately disappointed when I at last effected its capture.

This was the last place at which I collected in India.

Ceylon, lat. 7° N.

All the places that I visited in this beautiful island were within twenty miles north or south of the seventh parallel of latitude. The luxuriance of the vegetation was an immense relief after the parched plains of India. At the lower elevations it was more distinctly tropical than any that I had yet seen, but this character was lost at greater altitudes.

Peradeniya, alt. c. 1200 ft.

March 10th, 1904.

These justly celebrated gardens lie about four miles south of Kandy near the centre of the island. Their situation is beautiful and all the familiar "hot-house plants" grow luxuriantly. Splendid palms of many kinds, huge bamboos almost as tall, *Dracænas, Crotons, Acalyphas, Marantas,* nutmeg, cinnamon, camphor, huge trees of *Ficus elastica* with roots spreading far over the surface, etc., etc. Grass has been largely ousted by the sensitive-plant, *Mimosa pudica,* which, introduced from South America, has run wild. It grows about a foot and half high, and when one walks through it a broad path is left owing to the collapse of the leaves.

Here, well out of reach, I saw my first *Ornithoptera,* truly it is well named; I missed a second specimen through sheer excitement. Several *Catopsilia pomona* were netted, one was a female verging on the *catilla* form, the others were typical males, one of which had a slight scent. Of three male *Terias hecabe* two were wet-season, the other of "intermediate wet" form. A male *T. libythea* was also of wet-season type, a female was also taken. The only Nymphalids noted were two *Neptis varmona* and several *Precis iphita.* Here also I took my first *Parantica ceylonica,* Feld., a Danaid found in abundance later.

Of *Mycalesis mandata,* Moore, I only saw one, but the pretty little *Yphthima ceylonica* was swarming amongst the sensitive-plants. Mr. E. E. Green, the entomologist to the Ceylon Government, suggested that its colouring might be indirectly protective, since on the wing it looks much smaller than it is, only the white posterior two-thirds of the hind-wings being conspicuous, and these the least vitally important to the insect. The only Blue seen was *Zizera karsandra,* Moore.

A second visit to the gardens, rather late one afternoon, produced no insects, but gave me my only sight of a wild cobra, about 2½ feet long, with a very large "hood"; it crawled quickly away into the roots of a "travellers' palm."

Unfortunately for me Mr. Green was on the point of going to England on leave, but though busy with his preparations for departure, he was good enough to show me several very interesting things, such as larvæ of the

leaf insect, young snakes, etc., and above all he gave me some very useful advice. Peradeniya, he said, was not as rich a locality as Kandy; and, as regarded the highlands of Ceylon, he told me that, at any rate at that time of the year, Lepidoptera were for the most part confined to certain favoured spots, which it was unlikely that I should hit upon. He therefore strongly recommended me to concentrate my attention on "Lady Horton's Drive" at Kandy.

Kandy, alt. 1500 ft.

March 11th—15th, 1904.

On the south side of the artificial lake at Kandy stand some low hills, covered for the most part with natural forests, through which have been cut a number of roads named after the wives of former governors. Lady Horton's Drive is one of these, which runs about half-way up the hill, winding around its southern and eastern slopes. A wide road, bounded on either side with forest of rich and varied tropical growth, lying fully open to the morning sun, commanding moreover a glorious view over groves of palms to the bluest of distant hills, it affords an almost ideal collecting-ground. The climate of Kandy, so far as I experienced it, is delightful, tropical heat tempered by elevation, and with a pleasant softness in the air, yet free from the excessive damp of many places within the tropics. Its vegetation is by far the richest that I had seen. My pleasure in collecting in this earthly paradise was greatly enhanced by the companionship of Mr. W. G. Freedley, junr., a Philadelphia gentleman who had been collecting butterflies in Borneo, Celebes, Japan, Macao, etc.

In such a locality it was perhaps to be expected that Pierines would not be dominant, at any rate so it was. By far the commonest of the family was *Catopsilia pomona*, of which the males were very abundant, but strong fliers and by no means easy to catch. We remarked that they usually all flew in the same direction, and that uphill. As the females were comparatively scarce one was not surprised to see more than once signs of jealousy on the part of the males. I detected a slight jasmine-like scent in the male on stroking the "scent tufts" on the hind-wings. A female *Terias hecabe* had apparently been bitten in both hind-wings when at rest, the injuries being

more or less symmetrical. *Delias eucharis* was scarce, *Catophaga paulina* more common. In one case I saw a bird try to catch a specimen of the latter on the wing; the bird missed its quarry, but I was more successful; it proved to be a male.

The Danaids were well to the front, the commonest species being *Parantica ceylonica*; it is smaller and greyer than *Tirumala limniace* and varies considerably in size, a small male measuring only 2·5 in., a large female as much as 3·4 in. across the wings. It was curious that this species became quite abundant late in the afternoons, as other things were retiring. I was surprised to find that a male when fluttering in the net gave out a strong scent like that of *Crastia core*, *i.e.* very like acetylene. This was noted in two or three specimens, and was quite unmistakable. *Danais septentrionis*, Butl., appeared to be rather common. A female has the hind-wings much broken, perhaps from the bite of a lizard, but the breakage is only in part symmetrical. *Limnas genutia*, of which I took a very small one, was very scarce, and I did not see *L. chrysippus* at all. The genus *Crastia* was represented by many individuals. I took five *C. asela*, Moore; of one of them I noted at the time, "has a scent as in *core*."

But the most prominent group of butterflies at Kandy was assuredly the *Papilionidæ*; I met with six species. The most remarkable was *Ornithoptera darsius*, Gray, peculiar, I believe, to Ceylon, an insect that I had greatly wanted to take; it appears to be fairly common, as I saw two at Peradeniya, seven or eight at Kandy, and two at Haragáma. It sails about somewhat slowly and in a dignified manner, looking very distinguished in its rich yellow-and-black livery and impressive by its size, five and a half to six inches expanse of wings! When it comes within reach it is not hard to catch, and I secured two males and a female, but it is a formidable-looking creature in the net, with a thorax suggestive of a Bombyx. Mr. Freedley told me that the males have a scent like sassafras, but I learned this too late for confirmation. The male *Papilio pammon* was common enough, one specimen was unusually small, measuring under three inches. Two specimens of *P. aristolochiæ* (a distasteful butterfly) were brought home; one of them has the tips of the hind-wings up to the tails bitten off quite symmetrically, thus much resembling the mutilated specimen of *P. hector* taken at Kallár. Of the tailless

P. dissimilis, L., I took three, but probably saw more, since it so very closely mimics *Tirumala limniace* or a large *Parantica ceylonica*, as easily to pass for one of those insects; it is indeed most easily distinguished from them by its habit of fluttering while feeding on a flower. One of my specimens has the anal angle and a great portion of both hind-wings bitten off in an almost symmetrical manner, suggesting the bite of a lizard. It should be noted, as was observed long ago by the President, that, whatever the cause may be, it is in the great majority of cases the *hind-wings* that suffer these injuries; doubtless the framework of the fore-wings is the stronger, but that does not seem to be a sufficient explanation, since from their greater length they must be more exposed to chance injuries from thorns and the like. Mr. Freedley took a *Papilio* that mimicked *Euplœa*, but I believe that *P. dissimilis* is dimorphic, one form mimicking each genus. Indeed it would appear that the name *dissimilis* implies that its bearer is like anything rather than a *Papilio*.

In a shaded glen down which a tiny stream and a foot-path strove for the possession of the ground, I took close to the water a faded specimen of my Kallár acquaintance *Papilio telephus*, and missed another that was drinking at the mud. But far more exciting than all the before-mentioned species was *Papilio polymnestor*, or as Moore has it, *P. parinda*, a truly magnificent fly that dashed about in all directions. It measures about 5½ inches across the wings and is rendered most conspicuous by its colouring—French-grey and black. It rarely settled and was very hard to catch; Mr. Freedley and I were constantly striking at it, but it almost always eluded us. After many fruitless attempts I succeeded in netting two, one so battered that its powers of flight were seriously impaired; Mr. Freedley was even less fortunate, probably because he had a very small net.

There was yet another *Papilio* which eluded me altogether. It was black-and-green and I feel pretty sure *P. agamemnon* [which I also missed at Kallár in the Nilgiris]. It had the extraordinary and most aggravating habit of flying up and down, or rather backwards and forwards, just like a sentry, over some small trees below the road. Its path, if one may so call it, was about a dozen yards in length, and it always turned round at the same place, moving by a succession of jerks. I once actually

watched it for twenty minutes so occupied, it then settled for a moment on a *Lantana* flower; I struck at it and missed, and the performance began again! Another day I saw it at its post as before. Of all the Papilios that I saw this species was by far the wariest.

In striking contrast to the Papilios in every way are the Satyrids. A single *Calysime* [*Mycalesis*] *perseus* [? = *medus*, Fab.] was a very dingy shade-lover. The bright little *Yphthima ceylonica* was abundant; so far as observed it sits upright. *Nyssanga patnia*, Moore, a very distinct species, with leaden metallic lines on the under-surface, was fairly common at the edges of woods, but I did *not* meet with it on the "patnas" or grassy plains of the highlands of Ceylon.

The Nymphalines met with included several interesting species, notably *Cynthia asela*, Moore, of which I saw a very fine example, but caught only a very tattered fellow. It seems to like sailing about over the trees. With *Cethosia nietneri*, Feld., I had similar ill-luck. Of *Cupha placida*, Moore, again I have but a very worn specimen annotated thus: "Has the swift flight and to some extent the habits of *Precis*, but is fond of resting on the leaves of trees." These remarks are probably intended for, or at least include, the allied *Cirrochroa cognata*, Moore, which was certainly common, though very local; one of my five specimens, otherwise in good condition, has *two* snips taken out of each hind-wing, symmetrically, but it appears to be an insect readily chipped. Both these species have fulvous wings with black tips, so they are readily confounded in the field.

Neptis varmona might be said to be abundant, while its ally, the brown-and-black *Rahinda sinuata*, Moore, was decidedly common. In this connection may be mentioned the Erycinid *Libythea rama*, Moore, which appears to mimic *Rahinda*. I secured one specimen at Kandy, and believe that I missed another in the Pashók tea-garden near Darjiling.

I saw no females of *Hypolimnas bolina* at Kandy, but took three males, one of which had lost both the anal angles of the hind-wings, the injury being in part symmetrical. *Precis iphita* was common, so was *P. atlites*, looking on the wing like a dingy *Neptis*; a new brood appeared on March 14th. *Ergolis merione* was common.

The Lycænids were not well represented, but I saw

several *Loxura atymnus*, Cr., var. *arcuata*, Moore; as usual *Lampides celeno* was common, almost spangling in the sunlight, one specimen was so unusually brilliant as to recall *L. adonis*; *Talicada nyseus* brought up the rear.

The Skippers were represented by single examples of *Parnara mathias*, a dark fulvous *Iambrix salsala*, Moore, and the dingy *Spalgis epius*, Westw.

At rest on a fence outside the "Queen's Bath" I found one morning a fine Sphinx, *Meganotum melanomera*, Butl. A very distinct-looking Arctiid having a crimson body and light pink fore-wings, with a longitudinal fuscous streak, *Creatonotus interrupta*, Linn., came to light, as also did *Eupterote diffusa*, Walk., a Lasiocampid.

A few insects of other orders forced themselves upon me, busily occupied as one was, *e.g.* a very large, black ♀ carpenter-bee, *Xylocopa tenuiscapa*, West., with peacock-green wings; a very large, evil-smelling, brown bug, covered beneath with a waxy substance that during life glistened like silver, *Tessaratoma javanica*, Thunb. Another bug, *Chrysocoris stockerus*, L., was an intense metallic green with black spots; yet more conspicuous than any of these was the large Fulgorid *Hotinus maculatus*, Oliv., or so-called Lantern-fly, expanding three inches across the wings. Its fore-wings are black-and-white, the hind-wings light blue with a very broad black border. This was fairly common, flying high and settling on tree-trunks out of reach, but easily disturbed, when it flies off to a similar resting-place.

Haragáma, 11 miles S.E. of Kandy.

March 12th, 1904.

This appears to be locally recognized as a great place for butterflies; the collecting-ground is along the course of a rapidly-flowing stream with wooded banks, perhaps 500 ft. below Kandy, or say, 1000 ft. above sea-level.

Again, I had the advantage of Mr. Freedley's company on the occasion of my expedition. The first thing to catch our attention was *Hebomoia glaucippe* careering about in considerable numbers, but most unwilling to be caught.

The pretty little *Talicada nyseus* was literally swarming. I cannot remember ever having seen a Lycænid in such numbers. I repeatedly observed this butterfly settle with

its head upwards and immediately turn round so that its head looked downwards. This habit of resting with the head down is common, if not general, in the family, and has an obvious bearing on the protective use of tails, anal lobes, and directive marks.

Zizera otis, Fab., was also in abundance, and *Lampides celeno*, Cr., was common.

Tirumala septentrionis was not common, and the specimens netted were tattered males; one had a symmetrical injury near the anal angle of the hind-wings, possibly due to the bite of a bird. I saw a few specimens of *Crastia asela*, Moore, and secured two males, which exhibited the "acetylene odour."

Neptis varmona was common, and I took a specimen of the elegant Nyctemerid day-flying moth *Trypheromera nigrovenosa*, Moore, which seems to mimic it. Of the beautiful *Nepheronia ceylonica* I took one male. *Cirrochroa cognata*, Moore, was noted flying about a particular tree and did not appear to be attracted by flowers; I only saw it in that one spot, and the two taken were in poor condition. It is very like *Cupha placida*, Moore [= *Messaras erymanthis*, Stgr.], of which I took a fine specimen close by, at wet sand. I again confounded the two species as at Lady Horton's Drive. A few *Ergolis ariadne* and several *Nychitona xiphia* were seen. A male *Huphina nerissa* had the sweet-briar scent; a female was in fine condition.

At the furthest point reached in our walk, by a little bridge, two or three spots in the damp sand appeared to be very attractive. Besides the *Cupha* already mentioned there was *Ixias pyrene*, var. *cingalensis*, and *Papilio pammon*, the male, was rather common. [It was also seen flying about bushes, but not at flowers.] My Kallár friend *Catophaga paulina* was literally in crowds; they were all apparently males, sitting in dense clusters, their pointed white wings suggesting to me toy encampments. I easily netted ten at one swoop, while Mr. Freedley by a more cunning movement succeeded in getting as many as thirty-four into his net! In the same place I saw six or seven of the beautiful *Papilio telephus*, Feld., settled quite close together, and managed to secure three. It is a black-and-green species not easy to distinguish from *P. jason*, L.

The females of *Catophaga paulina* were common at flowers. One of the males, by the way, had a symmetrical injury to the *tips* of the hind-wings, but I can hardly see

how it could have been inflicted by an enemy without simultaneous injury to the fore-wings.

This day I saw two *Ornithoptera darsius*, one quite out of reach, the other I missed badly.

Hatton, alt. 4200 ft.

March 16th—18th, 1904.

In going up-country from Kandy when near Ullapáne station [alt. c. 2500 ft.] I caught, *from the train*, *Narmada montana*, Feld., and a little further on, c. 3000 ft., a male *Catophaga paulina*, a species that is very abundant in the Ceylon highlands.

Before Hatton is reached the line enters the tea country, whence the glorious primæval forests have disappeared, having been ruthlessly and completely cleared out to make way first for coffee and later for tea. Though doubtless "grateful and comforting," the tea-plant is most unpicturesque, only slightly surpassing the potato in that quality. The *Grevilleas* with their light feathery foliage, planted in regular rows to slightly shelter the tea from sun and wind, do but little to relieve its stiffness, and are a miserable substitute for the departed woodland glories. About Hatton there are but scraps of the forest left on the tops of the highest hills, and we were told that the tea-planters are constantly urging the Forest Department to allow these to be improved away. It results that what once was doubtless a grand entomological locality is now a very poor one.

Here for the first time I examined *Catophaga paulina* for scent, and was surprised to find that the three males tested had a scent nearly as strong as that of *P. napi*; it was described at the time as "like sweet-briar, but sweeter and more luscious," and I wrote to Dr. Dixey the same evening, adding "I had no doubt whatever."

About the hotel garden *Argynnis niphe* was common, a male had the fore-wings notably shorter and broader than usual.

A short walk in what is left of the old forest, towards the top of a high hill, say at about 4500 ft., produced several specimens of *Lethe daretis*, Hew., a regular sylvan Satyrid, repeatedly settling on the path, apparently always erect. Two of them have lost large portions of the hind-

wings near the anal angle, one symmetrically and in a way to suggest the bite of a lizard. On the under-surface of this butterfly the unusually large light-coloured scales on a black ground near the hind margin of the hind-wings are striking. In the same scrap of forest I took a single specimen of another species of the same genus, *L. drypetes*, Hew. [=*embolina*, Butl.]; also settled on a leaf of a tree far from the ground, as is usual with the genus, a *Limenitis calidasa*, Moore. Several *Atella phalanta*, a few *Neptis varmona* and *Terias hecabe* were also seen, a female of the last-named being of the "completely wet" form.

A specimen of *Cyaniris singalensis*, Feld., is very like our *argiolus*. With some difficulty I secured a specimen of the large black-and-white Skipper, *Celænorrhinus spilothrys*, Feld. This is the second Skipper [the other being *Caprona ransonnettii*, Feld., at Kallár] that I have seen settle on the *under-side* of a leaf during *full sunshine*, the wings being expanded like a Geometer's. Another specimen was settled on a rock with its wings expanded in like manner.

In the hotel I found a fine Burnet (Syntomid) *Euchromia polymena*, Linn., at rest on a wall, it has slender black wings bearing orange spots, the body is blue, ringed and collared with scarlet; and in my bedroom took a beautiful little Tortrix-like Noctua, *Metachrostis incondita*, Butl., measuring only 17 mm. across the wings; also a most formidable-looking long-waisted wasp, *Eumenes petiolata*, F., a ♀, and *Pomasia psylaria*, Guén., a pretty little yellow Geometer with metallic markings, evidently attracted by light.

When coming down from Adam's Peak on March 18th, at the height of about 6000 ft., I saw several of the Lithosiid, *Asura uniformis*, Hmpsn., but in the rough scramble of the descent could only secure one; at about 4800 ft. were several *Talicada nyseus*, and a few hundred feet lower down I bottled two green beetles, somewhat resembling our Rose-beetles, but much more shiny, *Coryphocera elegans*, Fab.

Nuwára Eliya, alt. 6200 ft.

March 18th—21st, 1904.

This Sanitarium is in some respects like Útakamund, it is situated on a grassy plain forming a basin among

mountains. The "patnas" or grassy areas are bounded by woods, which in their turn are fringed by somewhat stunted scarlet rhododendrons. At the best season it doubtless affords excellent collecting, but I found Mr. Green's statement, that I should be unlikely to light upon the good localities, amply confirmed.

I saw several *Papilio teredon*, Feld., flying about, and secured two that were drinking at wet mud. A female *Terias hecabe* proved to be of the wet-season form. Of *Neptis varmona* I took two. In a sedgy place surrounded by wood, a small "patna," I took the Skipper *Baracus vittatus*, Feld., curiously enough the only butterfly that I had taken in a swamp up to that date. The streaky markings of the under-side, following the veins, appeared when the insect was settled on sedge to be strongly protective. Of *Talicada nyseus* I saw several, the only other Blue seen was the *argiolus*-like *Cyaniris lanka*, Moore, much battered.

Among moths I found one of the yellow Geometer *Corymica specularia*, Moore, at rest on a tree-trunk, and one Acidaliid *Idæa costata*, Moore. Also on Mt. Pederutalagalla, at about 8000 ft., the Skipper *Baracus vittatus* among sedgy grass and *Abraxas sordida*, Hmpsn., flying at dusk, nearly uniformly dark fuscous. This last is presumably a scarce insect since the British Museum possesses the type only.

Hakgála, alt. 4800 ft.

On March 19th and 21st I visited the beautifully-situated and well-kept Botanical Garden at Hakgála, some five miles south of Nuwára Eliya and at a considerably lower elevation.

Along the road *Catophaga paulina* was swarming, males with their sweet-briar-like scent appeared to largely predominate. They flew rapidly and always in the same direction, roughly speaking from south-east to north-west. They frequently flew in strings, just as if they were tied together, and reminded me strongly of the strings of floating stars that are dropped by a certain kind of rocket; I often saw three, four or five, and once even seven, so following their leader's every movement.

At a turn of the road close by the garden there was a

small patch of a tall, but small-flowered composite plant (of the Thistle-head sub-order); this plant did not appear to be common in the district, but it was especially attractive to a black Danaid, which was quite abundant within the limits of this plant's distribution. *Chittira fumata*, Butl., is very distinct and handsome on the wing, its flight is slow and it is easy to catch, but like all Danaids it has a tough integument and is very tenacious of life. The favoured flower was so attractive to the butterfly that it would even go into deep shade to visit it. *Chittira fumata* may be said to be gregarious; it has the "acetylene" odour of *Crastia core*, but not so strong and with a difference. I made no observation as to the relation of scent to sex in this species, which, by the way, I believe I missed at Hatton.

Near this same spot I took two *Crastia asela*, Moore, and saw others. I also got one *Danais septentrionis*, Butl.

The inevitable Lycænids were worn *Talicada nyseus*; *Jamides bochus*, Cr., one; and *Polyommatus bæticus*, which was common.

It was interesting to watch the pretty little honey-birds feeding at some tall spikes of flowers.

Horton Plains, alt. 7000 ft.

March 23rd, 1904.

This beautiful district gives one some idea of what Ceylon was before the era of tea-planting. Situated about 2500 ft. above the railway and approached by steep zigzag paths through rather poor woods, are extensive rolling plains of coarse grass, locally called "patnas"; these are surrounded by woods having a general temperate zone character, but with here and there an epiphytal orchid to remind one that the latitude is but 7° N. In the swampier parts of the patnas the devastating work of wild pigs was evident enough, while the paths through woods, and unmistakable droppings, proved that wild elephants had passed not many days before. It was however not the season for butterflies, the air being too exhilarating for their luxurious ways.

About half-a-dozen *Chittira fumata* were seen at elevations of 6000—7000 ft., mostly at their favourite

composite. On the patnas and among sedges in the woods were a few of the Skipper *Baracus vittatus*, they were not easy to see. I was surprised to come across no other butterflies on these patnas, which seemed the very place for such a Fritillary as *M. aurinia*, Rott., or such a Satyrid as *C. pamphilus*, L., or at least for a Blue, but no, even the eponymous *Nyssanga patnia* was not to be found.

In the woods I took two specimens of the beautiful *Lethe daretis*, Hew., and saw two or three others. They frequented shady paths and flew but a short distance, settling upon a trunk or branch, reminding me strongly of *P. ægeria* in my own garden at Mortehoe. The only *Argynnis* seen here (or indeed in Ceylon) was *A. niphe*; it was rather common in open spots in woods, the female looking on the wing very like *Limnas chrysippus*; a specimen taken, a female, had the apices of both hind-wings and the anal angle of both fore-wings symmetrically bitten.

Of *Terias hecabe* I found a few in a wood, of the intermediate dry form. *Neptis varmona* was not uncommon in the woods, as usual flying in a ghostly manner, and usually settling upon leaves of trees. In the same woods *Cyaniris lanka*, Moore, was common, but it was astonishing to see so few insects in such a locality.

Haputále, alt. 4500 ft.

March 23rd, 1904.

At this beautifully-situated Rest-house, overlooking the plain and the old Boer prisoners' camp, a great many moths came to light.

Owing to its large numbers the most prominent of these visitors was the small Noctuid, *Ploteia frontalis*, Walk., an extraordinarily variable species; another Noctuid was *Cosmophila xanthindyma*, Boisd.; there were two Deltoids, *Olybama lentalis*, Guen., and *Rivula basalis*, Hmpsn.; the Lymantriad *Dasychira inclusa*, Walk., and the extremely widely-distributed *Plemyria fluviata*, Hübn.

The formidable-looking beetle, *Xylotrupes gideon*, L., was an uninvited visitor to my bath-room.

On the same day an Acidaliid, *Idæa costata*, Moore, flew into my face in a tunnel near Ohiya station, alt. 5000 ft.

Colombo, at sea level.

March 25th and 26th, 1904.

Following Mr. Green's advice I went to the Museum and was well rewarded, though too pressed for time to reap all that I might have got by a more deliberate examination of the local collection of butterflies.

My collecting-grounds at Colombo were the Victoria Park, much exposed to the sea wind; the old Cinnamon Garden, said to be much worked for insects by the Museum "boys"; and the old Dutch Cemetery. None of these were very promising or very productive.

However, I saw here for the first time in Ceylon *Limnas chrysippus*; I also netted one *Parantica ceylonica*, and missed what I feel certain was a *Hestia*, probably *jasonia*, Westw., which is, I believe, common at Colombo.

Precis atlites was common in the Dutch Cemetery but worn, so was *P. almana*, nearly all of the wet-season form, *P. asterie*, L.; one specimen however was dwarfed and another was of the "dry" form with the ocelli rudimentary. *P. almana* would appear to be the more prevalent species in Ceylon and Southern India, where it replaces *P. orithyia*, so universal in the North.

I saw several *Delias eucharis* in the Victoria Park, and once more noticed their fondness for lofty flowering trees; those taken were males. In the same place I missed what I think must have been the *catilla* form of *Catopsilia pomona*; its congener *pyranthe* was common and I took two males. Once more *Telchinia violæ* was common, but of *Papilio aristolochiæ* I have only one to record. Of *Yphthima ceylonica* I took two.

Of the Blues there were several species; *Nacaduba noreia*, Feld., was very abundant and decidedly gregarious, it positively swarmed in Victoria Park, though good specimens were scarce. *Everes argiades*, Butl., var. *parhasius*, Fab., and *Zizera karsandra*, Moore, were also both of them abundant. I took also a single worn specimen of *Castalius rosimon*, Fab.

English is more spoken in Ceylon than in most parts of India, but the Cingalese appear more noted for fluency than accuracy; the inner meaning of the following apparently strange request of a lad is easy to fathom: "Master, buy some butterflies, ready-made." On getting back to the hotel from an entomological expedition one of

the messengers came up to me and said: "Missie told you to told me they had gone in."

An immature locust, *Truxalis nasuta*, L., taken in Victoria Park, completes the list of my captures in Ceylon, an island that I was truly sorry to leave and that will always occupy a treasured place in my memory.

Summary of Bionomic Observations.

Injuries by enemies.

Specimens of the following twenty-eight species were taken which appeared to present injuries caused by the bites of birds or lizards; save in the two cases specified the hind-wings had borne the brunt of the attack.

Tirumala septentrionis, two.
Cirrochroa cognata.
Precis lemonias, two.
Precis almana.
Hypolimnas bolina, ♂.
Hypolimnas misippus, ♂.
Pyrameis cardui (fore-wings).
Vanessa kashmirensis.
Argynnis niphe, ♀.
Yphthima hübneri.
Lethe daretis, two.
Curetis thetys.
Ilerda epicles.
Pratapa deva.
Polyommatus bæticus.
Colias fieldii.
Catopsilia pyranthe.
Ixias pyrene.
Terias hecabe, two.
Terias læta.
Catophaga paulina.
Ganoris canidia.
Belenois mesentina.
Teracolus etrida (fore-wings).
Papilio hector } red marks on hind-wings attacked.
Papilio aristolochiæ }
Papilio pammon.
Papilio dissimilis.

It will be noted that this list includes no *Limnas*, but does include two *Tirumala septentrionis*, and two Papilios with conspicuous red "warning marks."

In Ceylon a bird was seen to make a swoop at a male *Catophaga paulina*, but missed it. I may here add that at Yokohama, May 19th, 1904, I saw a dragon-fly of moderate size, *Orthetrum japonicum*, Uhler, carry off a *Blanaida goschkevitschii*; this is a butterfly resembling a very large *Pararge megæra*; it did not appear to struggle at all.

Sideways attitude or "list" when at Rest.

In December, 1878, Col. C. T. Bingham noticed this resting attitude in a species of *Melanitis*, but the account was not published till many years afterwards.* E. H. A.'s papers in the "Times of India," which contained a reference to this habit in *M. ismene* (p. 203), reappeared as "A Naturalist on the Prowl" in 1894.

In the summer of 1903 Dr. Dixey and I noticed this habit in several British Satyrids at Mortehoe, N. Devon. In *Epinephele janira* the list may amount to 15°—30°; in *E. hyperanthus* (G. B. L., 1894) to 20°; in *Pararge ægeria* and *P. megæra* to 25°; but in *Satyrus semele* it reaches 40° or even 50°. This list may be to right or left in the same individual. The insects appear to settle in the upright position, then to draw the fore-wings partly within the hind-wings, and by a third distinct movement to throw themselves over to one side or the other.

To the above insects having this habit I can now add the following Indian Satyrids:—

Mycalesis indistans, slight list.
Hipparchia parisatis, 20° to 30°.
Aulocera swaha, 45° to 50°.

In the last-named species the same individuals were observed sometimes to go over to the right, sometimes to the left; one was seen to make three efforts, getting further over each time. A specimen of *H. parisatis* was observed *walking about* with a list of 20°.

To these observations I may add that at Yokohama, May 19th, 1904, *Blanaida goschkevitschii*, a Satyrid like a large *P. megæra*, was observed with a list of 40°.

There is no doubt that this sideways attitude makes the insects less conspicuous when resting on a flat surface, but

* See extracts from Col. C. T. Bingham's Diary for December, 1878, quoted in Trans. Ent. Soc., 1902, p. 363.

I have satisfied myself from observations on English Satyrids that the attitude is more often adopted by the butterflies when sitting in sunshine than in shade. Now if the list be away from the sun the shadow would be increased, but if towards the sun it would be diminished, in some cases even to extinction. Numerous observations are required to determine whether the list has any relation to the sun's position. I would however remark that in the case of a butterfly with cryptic colouring on the under-side the shadow is in many cases far more conspicuous than the butterfly itself, as I frequently observed in India. Obviously, therefore, economy of shadow might be a considerable protection. Now, near Simla in October, 1903, in the case of *Pararge shakra*, a butterfly closely resembling *P. megæra*, I noted three individuals in succession settled with their backs to the sun so as to reduce the shadow to a mere line. This was unfortunately just as I was leaving the locality where the species occurred, but I did not observe any instances to the contrary. I should add that in *P. shakra* I looked for, but did not find any list.*

Scents in Butterflies.

Owing to the imperfections of the human nose these are very difficult to detect and to describe, nevertheless certain definite results were obtained.

* Since the reading of the paper Prof. Poulton has called my attention to the following interesting observation by Mr. E. E. Green. "*M. ismene* is an adept at concealing itself. It usually pitches amongst fallen leaves where its form and coloration are sufficient concealment. But even on bare ground the insect is often extremely difficult to localize, though the approximate spot may have been carefully noted. I have watched the fly, immediately after pitching, alter its position so that its axis is directed towards the sun, thus casting no shadow."—"Notes on some Ceylon Butterflies, *Spolia zeylanica*," vol. ii, pt. vi, Aug. 1904, p. 76.

For the following reference I am also indebted to Prof. Poulton :— Prof. G. H. Parker has clearly established that in the United States when *Vanessa antiopa*, L., after a flight settles in full sunshine with wings expanded, it speedily so adjusts its position as to place the axis of the body as near as may be parallel to the sun's rays, with its head turned away from the sun. Some of the genus *Grapta* have the same habit. He thinks they do this to display their colouring to the best advantage. The bearing of his interesting observations on the cryptic attitude of Satyrids is that they prove decisively that a butterfly can acquire the habit of definitely orienting itself. If one can do this for one purpose, another species may do it for a different purpose, *e. g.* concealment. Mr. Parker gives a Bibliography of the subject.—"Mark Anniversary Volume," Cambridge University, Mass., U.S.A., Article xxiii, p. 453–469, 1903.

(1) The *rapæ* scent. Dr. Dixey and I have observed a slight scent in *Ganoris rapæ* well compared by Mr. Selwyn Image to that of sweet-briar, though the comparison is not exact. Curiously enough I have been able to prove to my own complete satisfaction the existence of the same scent, or one scarcely distinguishable therefrom, in several Pierines, viz. *Delias eucharis, Ganoris canidia, Huphina nerissa, Catophaga paulina,* and *Belenois mesentina.*

I think it is confined to the male sex, but cannot speak very positively.

(2) The *brassicæ* scent. This is fainter than the preceding; I compare it to violet-powder. It is confined to the male. This scent I did not find in any Indian butterfly.

(3) The *napi* scent. Far the strongest, and quite unmistakable. It is by common consent compared to lemon-verbena, but it is not identical therewith. This I did not meet with in India, but it was unmistakable in the male of the Japanese *Ganoris melete,* Mén. [My specimens were of what Leech calls the Japanese spring form = *G. aglaope,* Motchulsky, = *G. megamera,* Butl.] It proved equally distinct in the male of *G. oleracea,* Harr., a North American form of *napi.*

That three species of one genus have as many distinct scents, but that one of these extends to members of several widely-separated genera is very remarkable, and to me at least totally unexpected. I cannot help thinking that when these scents have been more studied and are better understood they may prove of great value in the solution of phylogenetic questions.

(4) Several Danaids of different genera have a strong and distinct odour of a disagreeable character, very suggestive of acetylene. That it is possessed by the males I am certain, but cannot say whether it is confined to that sex. The species are *Crastia core, C. asela, C. amymone* (at Macao), *Isamia midamus* (at Hong Kong), *Parantica ceylonica,* and *Chittira fumata.* A single specimen of *Pademma kollari* had a somewhat similar odour. In several cases (in at least three of the above), the scent was so strong as to be distinctly perceptible when the butterfly was fluttering in the net (as it is indeed in the case of *Ganoris napi*).

(5) *Limnas chrysippus* has a faint unpleasant odour like cockroaches, or musk-rats. I suspected it to come from

the pouches on the hind-wings of the male, but more observations are needed.

In the case of *Limnas genutia, Tirumala limniace, Pararge shakra*, and *Colias nilgiriensis* the existence of scents was suspected, but the results were ambiguous.

(6) The observations of Wood Mason were confirmed in *Catopsilia pyranthe* and *C. pomona*. The tufts on the wings of the males gave out on stroking a scent that may be compared to jasmine, though I think it more like *Polianthes tuberosa*.

Seasonal Forms.

With a view to seeing what light, if any, my fragmentary observations might throw upon this puzzling subject, I have adopted the following method:

In the Register, or Index, of my captures I noted to every Pierine Dr. Dixey's estimate of its seasonal character, and then made my own (far less weighty) estimates of the seasonal characters of the genera *Precis, Melanitis, Mycalesis*, and *Ypthima*, and then analyzed the results for localities, or groups of localities. The seasonal characteristics were classed under the following five heads:—

(1) Wet-season form, including "wet," "very wet," and "extreme wet."
(2) Somewhat wet form, including "intermediate inclining to wet."
(3) Intermediate form.
(4) Somewhat dry form, including "intermediate inclining to dry."
(5) Dry, including "very dry" and "extreme dry."

Without prejudice, and for the purpose of this grouping only, I took *Catopsilia gnoma* to represent the dry-season form of *C. pyranthe*, and in like manner *Catopsilia catilla* and *pomona* to be dry-season forms corresponding to a wet-season form *C. crocale*.

It must be borne in mind that such a classification is necessarily very vague, for while the extreme forms are easy to place it is most difficult to assess the numerous intermediate specimens.

	Wet Season.	Somewhat Wet.	Intermediate.	Somewhat Dry.	Dry Season.	
Precis orithyia	2	2	...	...	4	Simla and Kalka, Oct. 10–20, 1903. Slight showers.
,, *œnone*	...	...	...	...	6	
,, *lemonias*	1	1	...	...	3	
,, *iphita*	...	...	...	...	1	
Catopsilia pyranthe	1	...	...	...	1	
Ixias marianne	...	...	1	...	...	
Terias hecabe	7	...	1	...	...	
,, *læta*	...	2	2	1	...	
Huphina nerissa	3	3	...	...	...	
TOTAL	14	8	4	1	15	
Precis orithyia	...	...	...	...	3	Peshawar and Malakand, Oct. 22–29, 1903. No rain.
,, *œnone*	...	...	...	...	2	
,, *almana*	...	...	...	...	4	
Yphthima balanica	1	...	...	...	...	
Terias hecabe	1	3	2	2	1	
Teracolus etrida	...	...	...	1	...	
TOTAL	2	3	2	3	10	
Precis orithyia	...	...	...	...	1	Lahore, Amritzar and Delhi, Oct. 31–Nov. 12, 1903. No rain.
,, *almana*	...	...	...	1	2	
,, *lemonias*	...	...	...	...	4	
Catopsilia pyranthe	7	...	...	...	...	
,, *pomona*	...	1	...	...	...	
Ixias marianne	...	...	1	1	3	
,, *pyrene*	1	2	1	...	...	
Terias hecabe	5	...	...	...	...	
Teracolus etrida	...	...	2	2	2	
,, *protractus*	2	...	...	...	...	
,, *puellaris*	1	...	1	1	3	
,, *calais*	2	2	...	...	...	
Huphina nerissa	...	...	...	...	2	
Appias libythea	...	...	...	...	1	
TOTAL	18	5	5	5	18	

	Wet Season.	Somewhat Wet.	Intermediate.	Somewhat Dry.	Dry Season.	
Precis orithyia	...	...	...	2	2	Naini Tal, Lucknow and Benares, Nov. 16–Dec. 2, 1903. No rain.
,, *œnone*	...	...	...	...	2	
,, *almana*	...	1	...	1	...	
,, *lemonias*	...	1	...	...	2	
,, *iphita*	...	...	...	...	3	
Yphthima philomela	...	...	...	...	1	
Mycalesis perseus	...	1	...	...	1	
Catopsilia pyranthe	1	...	1	...	2	
,, *pomona*	...	...	1	1	..	
Ixias marianne	...	...	...	...	1	
,, *pyrene*	...	...	...	...	1	
Terias hecabe	1	...	...	...	1	
Huphina nerissa	1	...	...	...	...	
TOTAL	3	3	2	4	16	

	Wet Season.	Somewhat Wet.	Intermediate.	Somewhat Dry.	Dry Season.	
Precis almana	...	1	...	1	1	Calcutta, Dec. 4–12, 1903. No rain.
,, *lemonias*	...	...	...	...	1	
,, *atlites*	1	1	...	1	1	
Melanitis ismene	...	...	...	...	4	
Mycalesis indistans	...	...	...	...	2	
Catopsilia pyranthe	2	...	...	1	1	
,, *pomona*	...	1	...	4	...	
Ixias pyrene	...	...	...	1	...	
Terias hecabe	1	...	2	...	2	
Huphina nerissa	1	...	...	...	...	
TOTAL	5	3	2	8	12	

	Wet Season.	Somewhat Wet.	Intermediate.	Somewhat Dry.	Dry Season.	
Precis lemonias	...	...	...	...	1	Darjiling, Dec. 13–22, 1903. No rain.
Melanitis ismene	...	...	...	...	1	
Mycalesis indistans	...	...	...	...	8	
Catopsilia pyranthe	...	...	...	1	...	
Ixias pyrene	...	...	1	5	1	
Terias hecabe	...	...	...	1	6	
,, *læta*	...	...	...	2	...	
Huphina nerissa	1	...	...	...	4	
,, *nadina*	...	1	...	...	2	
Tachyris hippo	...	...	...	...	1	
Prioneris thestylis	...	...	...	...	1	
Hiposcritia lalage	...	...	2	1	...	
TOTAL	1	1	3	10	25	
Precis orithyia	...	...	...	...	3	Bankipur, Jhansi, Agra, Jaipur, Ajmir and Mt. Abu, Dec. 24, 1903–Feb. 8, 1904. Slight rain Jan. 14–23.
,, *œnone*	...	...	...	...	1	
,, *almana*	...	...	...	...	2	
,, *lemonias*	...	...	...	...	1	
Yphthima inica	...	...	...	2	...	
Catopsilia pyranthe	1	...	...	1	2	
Ixias marianne	...	...	...	2	5	
Terias hecabe	2	1	...	1	2	
,, *læta*	...	...	3	6	10	
Teracolus etrida	...	1	5	2	3	
,, *puellaris*	...	...	...	...	1	
Huphina nerissa	...	...	...	...	7	
TOTAL	3	2	8	14	37	

	Wet Season.	Somewhat Wet.	Intermediate.	Somewhat Dry.	Dry Season.	
Precis œnone	...	...	...	1	...	Bijapur, Anantapur and Bangalur, Feb. 16–23, 1904. No rain.
,, *almana*	...	...	...	...	2	
Melanitis ismene	...	...	1	...	...	
Hypanis ilithyia	...	...	...	4	...	
Catopsilia pyranthe	1	...	...	...	3	
,, *pomona*	...	...	...	1	...	
Ixias marianne	...	...	...	2	...	
Terias hecabe	...	...	...	1	...	
,, *læta*	...	...	1	...	...	
Teracolus etrida	...	...	2	2	5	
,, *dulcis*	...	...	...	...	1	
,, *amatus*	2	...	...	...	...	
,, *eucharis*	...	...	...	...	1	
TOTAL	3	...	4	11	12	
Precis orithyia	...	...	...	1	...	Nilgiris, Trichinápali, Tanjur, Madura, Feb. 24–March 7, 1904. Very slight rain in Nilgiris.
,, *œnone*	...	...	...	...	1	
,, *almana*	...	...	...	1	...	
,, *lemonias*	...	...	...	1	1	
Melanitis ismene	...	...	...	...	3	
Mycalesis perseus	...	...	...	...	3	
Yphthima hübneri	...	...	...	...	1	
Hypanis ilithyia	1	1	...	...	...	
Catopsilia pyranthe	...	...	2	2	...	
,, *pomona*	...	...	...	1	...	
Ixias marianne	...	...	1	...	1	
,, *pyrene*	...	2	...	3	...	
Terias hecabe	...	...	2	1	2	
Teracolus etrida	1	...	...	...	...	
,, *eucharis*	...	...	...	...	1	
,, *danäe*	3	5	2	1	...	
Huphina nerissa	...	1	3	1	3	
Catophaga paulina	...	1	...	1	4	
TOTAL	5	10	10	13	20	

	Wet Season.	Somewhat Wet.	Intermediate.	Somewhat Dry.	Dry Season.	
Precis almana . . .	4	...	...	...	1	Ceylon, March 10–26, 1904. Several showers.
,, *atlites* . . .	1	2	...	2	2	
Mycalesis mandata . .	1	...	...	...	...	
Catopsilia pyranthe . .	2	...	...	...	...	
,, *pomona* . .	...	...	2	2	1	
Ixias pyrene . . .	...	...	...	1	...	
Terias hecabe . . .	4	2	1	...	1	
,, *læta* . . .	...	...	...	...	1	
Huphina nerissa . .	1	...	1	...	1	
Catophaga paulina . .	...	...	2	...	2	
TOTAL . .	13	4	6	5	9	

There was a storm at Simla on October 10th, and a few trifling showers during our expedition to Bághi, but we saw no sign of rain after that, and indeed scarcely a cloud, save at Kurseong, until January 14th, when there was a thunderstorm at Jhánsi. There were then several very slight falls of rain terminating with a long but not heavy rain on January 23rd. There was a very slight fall at Konúr on the night February 29th—March 1st. Then no further rain till Kandy, March 10th. There were several showers in Ceylon.

At Simla the effects of the monsoon were not quite past, and wet-season forms were slightly more numerous than dry; the same applies to Ceylon. At all the other places, as might have been expected, dry-season forms predominated. Calcutta occupies an intermediate position.

It must however be admitted that to prove a species to be dimorphic is not necessarily to prove that the forms are associated with seasons. In the genus *Precis*, so far as my very few observations (limited to the dry season) are worth anything, the two forms ocellated and non-ocellated seem

to be closely associated with wetness and dryness respectively. *Catopsilia pyranthe*, as Dr. Dixey has shown, occupies a far less clear position, and I may add that *Terias hecabe* did not appear to me to follow any rule. The two forms were taken together in most places.

Many dwarfed specimens of the genus *Precis* were met with as the season advanced; with the exception of one *P. almana*, var. *asterie*, they were all of the dry type, most of them markedly so. The smallest *Terias hecabe* was of the dry form, so was a dwarf *Teracolus dulcis*; four dwarfed *T. etrida* were half dry, half intermediate. A dwarf *Belenois mesentina* was dry, but a dwarf *Catopsilia pyranthe* and a dwarf *Huphina nerissa* were intermediate, while a dwarf *Teracolus calais* was actually of the wet-season form.

In conclusion I have to thank the President for much valuable assistance in many ways; I am greatly indebted to Mr. Hamilton H. Druce for most kindly naming all my Lycænids and Hesperids, to Sir George Hampson for much help in naming my moths, to Mr. W. F. Kirby for kindly naming my *Orthoptera* and *Neuroptera*, to Col. C. T. Bingham, Mr. G. E. Austen, and Mr. Claude Morley; to the Rev. F. D. Morice for naming my *Hymenoptera*; to Commander J. J. Walker, R.N., whose practical experience in many lands was of much assistance, and to Mr. W. Holland of the Hope Department for constant help, while to Dr. F. A. Dixey I am indebted not only for the names of all my Pierines and much information about them, but for continual encouragement and inspiration.

VI. *On some bionomic points in certain South African Lamellicorns.* By G. B. Longstaff, M.D., F.E.S.

[Read February 7th, 1906.]

Mr. Trimen, in the introductory chapter of his "South African Butterflies," after remarking on the poverty of the *Rhopalocera* of the Cape Peninsula as compared with the richness of its Flora, and stating that in that part of the world butterflies cannot perform a very prominent part in the fertilization of flowers, goes on to say: "The great number of densely hairy flower-frequenting *Coleoptera* in South Africa must also play a large part in plant fertilization." *

The beetles referred to are chiefly *Lamellicornia* of the sub-families *Cetoniinæ* and *Hopliinæ*.

Cetoniinæ.

As regards the former group, Dr. Dixey and I met with but eight species, being doubtless too early in the season. Of the beautiful gem-like *Oxythyrea hæmorrhoidalis*, Fab., which was not uncommon on flowers by the banks of the Nahoon and Buffalo Rivers, near East London, I have nothing to remark save that Fabricius might well have given such a beautiful creature a more appropriate name.

The more dingy *Oxythyrea marginalis*, Schönh., was first met near Pretoria on the lavender-coloured flowers of a Loganiaceous plant of the genus *Buddleia*, but at East London it was abundant, occurring sometimes on composite flowers, but mostly on the "Pride of Madeira" (*Echium fastuosum*), a Boragineous plant with a long dense terminal spike of small flowers with prominent stamens. The spikes are from four to six feet high with blue or creamy-white flowers, those in the Queen's Park being all of the latter variety; they proved very attractive to insects of several orders and especially to the small *Oxythyrea marginalis*, Schönh. I noticed at the time that this beetle was rendered strangely inconspicuous by the white specks on

* *Op. cit.* vol. i, p. 42, note.

thorax and elytra breaking up the dark ground-colour and simulating the general look of the anthers of the flower. Another small Cetoniid, *Stringophorus flavipennis*, G. and P., occurred on the same flowers and its elytra bear similar spots. Together with these were two specimens of a third and still smaller Cetoniid, *Comythovalgus fasciculatus*, Schönh., which were quite difficult to distinguish, but in this case the means of concealment was different, for the thorax and elytra bear numerous conical, horny projections, while there are two conical tufts of scales near the apex of the abdomen.

Two larger species, *Rhabdotis* (*Pachnoda*) *sobrina*, G. and P., dark olive-brown and white, and *Macroma cognata*, Schönh., dark chocolate-brown and canary-yellow, both seemed conspicuous enough, the one at the sweet white flowers of *Dombeia*, the other on the wing, but I strongly suspect that in their case too, when on an appropriate background the breaking up of the dark colour by light markings aids concealment.

With *Gametis balteata*, De G., the case is different. This beetle is black and red, or perhaps orange-brown more correctly describes its decoration. At East London, on one of the tributaries of the Buffalo River, there grows a profusion of a climbing composite with greenish-white flowers, a plant in general habit and appearance very suggestive of *Clematis vitalba*, L. On one of these plants I took a number of specimens of two species of *Haplolycus*, which are represented in the National Collection but as yet unnamed. These Malacoderms have the usual *Lycus* coloration, viz. orange-brown with the apical two-fifths of the elytra black, and a black stripe down the middle of the thorax. On the same day, on another bush of the same climbing composite growing a hundred yards higher up the stream, I took an example of *Gametis balteata*, De G., and was at once struck by the striking resemblance of the two insects. I may remind any Fellows who are not familiar with living specimens of beetles of the *Lycus* group, that during life the orange-brown colour is much redder than might be supposed from cabinet specimens, whereas the *Cetoniid* preserves its colour well.

The very next day Dr. Dixey saw both these beetles in some numbers (3 *Haplolycus* and 8 *Gametis*) in the Queen's Park on and about a flowering tree and noted their similarity. With them were two specimens of a Lycoid-coloured

Braconid (*Zombrus*, sp.). The *Gametis* resembles the *Haplolycus* the other way on, the head of the one being coloured like the tail of the other, but probably that fact does not detract from any benefit that it may derive from the likeness. Mr. G. A. K. Marshall has proved experimentally that Lycoid beetles are very distasteful to Kestrels and Baboons.* *Gametis balteata* may now be added to the wonderful synaposematic Lycoid group figured in Plate XIII of Mr. Marshall's paper.

Hopliinæ.

We met with thirteen species of *Hopliinæ* in Cape Colony. The most obvious characteristic of the group is the great length of their posterior legs. The development of these varies greatly in different species, but in the majority of cases is much greater in the males than in the females. Indeed in some species the male femora and tibiæ are grotesquely disproportioned to the animals; moreover both femora and tibiæ are provided on their inner sides with strong spurs or spines (perhaps better described as teeth). These strange limbs evidently attracted the attention of the older writers, since Fabricius named one species *dentipes*, and Burmeister another *forcipatus*. The explanation of these hypertrophied legs that is usually received is that they are used by the males to grasp the females. Mr. Trimen, accepting this explanation, tells me that he thinks that copulation is attended with especial difficulty in these beetles.

The latest writer on the subject, Mr. Péringuey, rejects the ordinary explanation in the following words:—

"The great development of the hind-legs is not intended for securing a better hold of the female. There is nothing more ridiculous than to see half-a-dozen males with their long hind-legs emerging from the pistils of a composite flower where they are mobbing a female which is almost entirely buried head foremost in the pistils, the sub-horizontal pygidium alone being exposed to view. But it is when disentangling themselves that the use of the long hind-legs becomes apparent; by means of his long, hinged claw the male hooks himself out of the corolla. It is not only amongst the flower-frequenting kinds that this extraordinary development of the hind-legs with their curiously

* Transactions Ent. Soc. Lond., 1902, Part II, pp. 340, 344, 380.

serrate, dentate and mucronate tibiæ is met with, because the species of *Hoplocnemis*, in which the development has become almost a monstrosity, do not feed on flowers, or at least have not been observed doing so. Their habits seem to be more those of certain *Dynastinæ*, and I suspect them to live, while in the larval state, in the excrement deposits of the subterranean white ant, *Hodotermes viator*, Latr." *

Mr. Péringuey, I am bound to say, fails to convince me, and I venture upon yet another explanation.

Many of the species of *Dichelus* and *Heterochelus* burrow

Diagram of posterior legs of *Heterochelus*, ♂. The body of the beetle is buried in the florets of a composite flower (× 5 diam.).

into the disks of composite flowers, eating out the ovaries. When so engaged the whole of the body of the insect may disappear from view, or the extremity of the abdomen may alone protrude, but in either case the hind-legs extend beyond the florets, widely separated and closely resembling the open jaws of an ant-lion. While picking one out of a flower I was startled by receiving a very respectable pinch, or bite, inflicted by the formidable teeth above referred to.

Now the suggestion that I have to offer is this: while probably in the first instance adapted to assist the male insect in grasping its mate, these huge hind-legs are now of great advantage to the otherwise helpless beetle when

* Transactions of the South African Philosophical Society, vol. xii, pp. 625, 626. *Descriptive Catalogue of the Coleoptera of South Africa, Hopliinæ*, by L. Péringuey, F.E.S.

burrowing into flowers in search of food. The widely gaping jaws may probably terrify some enemies, but they certainly afford by no means despicable weapons of defence against such foes as may presume to come to close quarters.

This suggestion meets with support from the fact that *Lepitrix lineata*, Fab., a pretty species that I found abundantly on the flowers of *Mesembryanthemum* at Simon's Town, has long thin hind-legs not provided with teeth, but, unlike *Heterochelus* and *Dichelus*, this insect is very active, taking to its wings almost as readily as a bee.

Dr. Dixey did not notice this beetle on *Mesembryanthemum*, but not far off found five specimens in spathes of the "Cape Lily," *i. e.* common white arum (*Richardia africana* = *Calla æthiopica*), three in one spathe and two in another. He says that they did not attempt to fly. Possibly the fact that they were to some extent enclosed in the arum, whereas those on *Mesembryanthemum* were exposed, may explain this notable difference of habit.

In conclusion I have to thank Messrs. C. J. Gahan and G. J. Arrow, of the British Museum Staff, for their great kindness in naming my South African *Coleoptera*.

VII. *Some Rest-Attitudes of Butterflies.* By G. B. LONGSTAFF, M.D., F.E.S.

[Read March 7th, 1906.]

ABOUT a year ago I called the attention of Fellows to the attitudes assumed by certain Indian butterflies when at rest, noting especially the following points: (1) Heliotropism, or the turning of the body-axis so that the head is away from the sun; (2) the habit of certain Lycænids of resting head downwards; and (3) a sideways attitude, a tilting or "list" of certain Satyrids to the right or left.*

Heliotropism.

Professor G. H. Parker appears to have been the first to describe what he terms the "negative heliotropism" of *Vanessa antiopa*, L., in the United States. He records his numerous observations in great detail, and states that some species of *Grapta* have the same habit. The object of the creature thus turning its tail to the sun is, he believes, to display its colouring to the greatest advantage.†

Mr. E. E. Green, describing the cryptic habits of *Melanitis ismene*, Cr., in Ceylon, says: "I have watched the fly, immediately after pitching, alter its position so that its axis is directed towards the sun, thus casting no shadow." ‡

Quite independently and perhaps at about the same time as Mr. Green (October 1903) I saw near Simla, *Pararge shakra*, Koll., settle three times with its back to the sun, and noted that its shadow was thereby reduced to a mere line. When a butterfly with cryptically coloured under-side rests upon a flat surface in bright sunshine its shadow is often more conspicuous than the insect itself, so that economy of shadow may be a valuable means of protection.

[The author showed specimens of South African Nymphalids set in the usual manner, but close to the paper, and also with the wings closed as at rest, placed upon

* Trans. Ent. Soc. Lond., 1905, pp. 85, 126, 135, 136.

† *Mark Anniversary volume*, Cambridge University, Mass. U.S.A., 1903, pp. 453–469.

‡ *Spolia Zeylanica*, vol. ii, pt. vi, Aug. 1904, p. 76.

backgrounds of sand-paper of various colours to imitate natural backgrounds of sand or rock.]

Admitting the fact of Heliotropism a third possible explanation suggests itself. This special attitude exposes not only wings, but the insect's body, most completely to the sun's rays, and we may fairly suppose that such an essentially sun-loving creature as a butterfly finds them agreeable. To this explanation Dr. Dixey advances an at least partial objection, viz.: that when the wings are closed up both wings and body are *least* exposed to the sun's rays.

As the result of numerous observations made in Algeria in February and March 1905, I satisfied myself that:

> Except early in the day, or when the sun is dull, or when feeding on flowers, *Pararge meone*, Cr., settles with the axis of the body turned so that the tail points more or less accurately to the sun, therefore when the wings are raised, in the attitude of repose . . . the shadow is reduced to insignificant dimensions.*

After somewhat intimate acquaintance with *P. meone*, Cr., in Algeria, it was pleasant, in May 1905, to study its northern form *P. ægeria*, L., which is common in and about my garden at Mortehoe, North Devon, and this was the more pleasant because our butterfly is undeniably much more beautiful than its southern sister.

I have notes on ten specimens observed, and it may be instructive to give them in detail.

> May 3. Observed two *P. ægeria*; one settled several times with tail to the sun, the other was less particular.
>
> May 9. Saw *ægeria* settled with wings open and tail directed towards the sun.
>
> May 15. Saw one specimen of *ægeria* settle twice with fairly accurate orientation; another specimen settled first accurately oriented; then it settled again with the body nearly at right angles to, but with the head somewhat towards, the sun; thirdly it settled again at right angles, but with its head turned to the opposite side.
>
> May 19. Watched three specimens of *ægeria* and saw each of them orient itself accurately twice. The same day I saw another specimen orient itself four times.

* Proceedings Ent. Soc. Lond., 1905, p. xxix.

My last observation was made on an *ægeria* within a few yards of my study window; this I disturbed many times with a view to noting its behaviour; out of seventeen occasions it oriented itself correctly but five times, it faced the sun once, but placed itself at right angles to its rays no less than eleven times!

The unusual behaviour of this butterfly gives strong proof that individual flies may differ much in behaviour, and as I should be disposed to describe it, in moral character. What entomologist who has sugared regularly in the same place has not observed among common *Noctuæ* some individuals bolder and greedier than others?

I often saw *meone* settle on sandy roads, rocks, or walls, but the *ægeria* here referred to were for the most part settled on leaves, and the question of protection by economy of shadow could scarcely arise in their case.

The next subject of observation was *Pararge megæra*, L., which was especially interesting to me as nearly allied to *P. shakra*, Koll., the common Himalayan butterfly in which I first noted heliotropism in October 1903.* The spring brood was not so numerous as the summer brood usually is, and only ten specimens were noted settled. Of these the first, a female, was watched on a Devonshire "dry ditch," settling for the most part on the rough slates of which it was built, that is to say, on surfaces not always well adapted for precise orientation. It was however observed to settle several times with its tail to the sun, and on one of these occasions it raised its wings over its back so that its shadow was scarcely visible, but two or three times it settled at right angles to the sun. Six other specimens were observed with their wings open, settled for the most part on flat ground, and all correctly oriented (one observed twice). Another specimen was first seen settled on the flowers of *Potentilla tormentilla*, Sibth., at right angles to the sun, but afterwards on *Scilla nutans*, Sm., correctly oriented. Yet two other *megæra* were seen settled, one on the road, the other on a flat stone, both with their wings closed up, correctly oriented, so as to throw practically no shadow.

During May 1905 hybernated specimens of *Vanessa io*, L., were unusually common at Mortehoe, and the attitudes of at least fifteen different individuals were noted on seven different days. Of these, eleven, or three-fourths, oriented

* Trans. Ent. Soc. Lond., 1905, p. 67.

themselves correctly so as to turn their tails to the sun. Of the minority, the one-fourth that settled otherwise than with tail to the sun, two were settled on the flowers of the wild hyacinth or "blue-bell" (*Scilla nutans*, Sm.), and of these one was facing the sun. A third specimen, settled on flowers of lilac (*Syringa persica*), appeared to be quite indifferent to the sun's direction. The fourth was at first settled facing the sun, but it very soon moved, settled again, and at once adjusted its position so as to be perfectly oriented with tail to the sun. I subsequently watched the same butterfly settle three times, the first time with tail turned to the sun correctly, but the second and third times it alighted on "blue-bells" and did not orient itself.

Vanessa urticæ, L., was far less common and only two specimens offered themselves for observation, of which the first was twice seen to adjust itself to correct orientation, but the second, on the same lilac bush with the *V. io* mentioned above, appeared like it to be indifferent to the sun's direction.

From the preceding observations it may fairly be inferred that *Vanessa io* (and probably also *V. urticæ*) when settled in full sunshine, except sometimes when feeding on flowers, habitually places itself so that its tail is directed towards the sun. As however the butterflies were not seen to close their wings over their backs nothing can be said as to the shadow question.

The next species that came under my notice was *Melitæa aurinia*, Rott., which was very abundant in a restricted North Devon locality. All the specimens observed were settled on flowers or low plants. In the great majority of cases the wings were fully expanded, though a few had the fore-wings drawn back so as to form an approximation to the "Deltoid" shape. In order to secure perfect fairness my method was to record the position of *every* specimen seen so long as the sun was shining brightly. Three series of observations were thus made, with the following results :—

	First series.	Second series.	Third series.	Total
Tail to sun.	13	29	69	111
Side to sun.	2	6	9	17
Head to sun.	1	2	0	3

Adjustments after settling were often noticed, occasionally repeated adjustments. When there was a wind

they settled at first with their heads to it, one butterfly succeeding in orienting itself only after much struggle. When the sun was not shining they were often noted settled at right angles to its direction.

In the case of *M. aurinia,* under the circumstances in which the butterfly occurred, it is difficult to see that the amount of shadow thrown could have been of any moment, though doubtless its colours would show up more if the under-sides of the hind-wings when at rest had the sun shining directly *on* them rather than tangentially.

The recent visit of the British Association to South Africa gave me more extended opportunities; it gave me moreover the advantage of Dr. F. A. Dixey's co-operation, which was the more valuable by reason of his great patience in observing and careful accuracy in recording results.

Eurytela hiarbas, Dru., is a Nymphalid butterfly, with a very Satyrine aspect and habits not unlike those of *P. ægeria.* It is common in woods round East London and Durban, affecting partial shade. At East London I saw it in a small wood within 100 yards of high-water mark. It does not seem to be attracted by flowers, but moves about bushes with a slow gliding flight; it may settle on leaves, or on the ground, the wings being commonly three-fourths expanded, though sometimes more fully. When thus settled the wings are often slowly shut in part and again opened, though I never saw them quite shut. On at least three several days they were noted to have their tails turned to the sun, but the orientation was imperfect, often 15°–30° out, and occasionally they settled with the body axis at right angles to the sun.

Precis clelia, Cr., is a Nymphalid butterfly that is common and widely distributed in South Africa. The dark upper surface of the wing is rendered very conspicuous by white spots near the tip of the fore-wing and a large blue spot on the hind-wing, but the under-side is marbled with shades of light grey and is very quiet and unobtrusive. As regards its habits I cannot do better than quote Dr. Dixey's very graphic account of its behaviour as observed in "the Old Cemetery," at Sydenham, near Durban, in the middle of August:—

> Common at one spot in the cemetery. It has a habit of flying a little way, sometimes in pursuit of another butterfly, making a round and returning to

> the same, or nearly the same place. It settles on the ground, or on a low plant, nearly always turning its back to the sun, and often closing its wings over its back. I saw one settle at right angles to the sun, casting a broad shadow; but as there happened to be several objects close by casting similar shadows, it was not very conspicuous. Presently the same individual flew up and settled down again, this time on a bare piece of earth and with its back to the sun in the usual way.

Another note, also relating to Sydenham, is:—

> *P. clelia* seen to settle, and then rapidly turn its back to the sun; it did not close its wings. *P. clelia* seen here seems *always* to turn its back to the sun.

To Dr. Dixey's description I would add that the wings are usually about three-fourths expanded, nearly as with *Vanessa atalanta*, L., at home. One specimen was observed to settle with tail to the sun five consecutive times. It was only occasionally that I saw them close their wings over their backs, when the shadow was reduced to a minimum, but I did observe this several times, both in the neighbourhood of Durban and at the Victoria Falls. As a rule *P. clelia* seemed to pitch correctly, but now and then it was seen to adjust itself.

Precis crebrene, Trim., is another common and widely-distributed South African butterfly. Though very differently coloured from *P. clelia*, it is nearly, though not quite, as conspicuous when the upper-side is displayed, but the almost uniformly clay-coloured under-side is scarcely distinguishable against certain back-grounds, such as sand, clay, or rock of a grey or yellow tint. It is fond of frequenting dry "spruits," or watercourses, settling on the rocks or boulders, but in the Zambesi country Dr. Dixey often saw it settle in trees. It was repeatedly observed to orient itself fairly accurately, but did not appear to close its wings as often as *P. clelia*. A note made by me at Ladysmith, August 26th, says:—

> Oriented within about 10°–15°; settled often upon cliffs of yellow sand or mud on which it was moderately conspicuous. One specimen was repeatedly observed to close its wings, its shadow was then near the minimum and the insect inconspicuous.

Precis natalica, Feld., a somewhat dingy species, though generally distributed, was much less common than the two preceding. It is somewhat of a shade-lover and usually settled on the ground or on a leaf, its wings more spread than *clelia* or *crebrene*. Except when settled in the shade its tail was directed towards the sun. One was seen to close and open its wings, another was watched for some time and observed over and over again to orient itself correctly, and twice to close its wings so as to leave practically no shadow.

Precis elgiva, Hew., is not uncommon in woods near Durban, it was noted as sitting with wings fully expanded and tail to the sun.

Precis sesamus, Trim., is a large, dark, handsome butterfly which reminds one of *Vanessa io*, L. It is fond of hiding itself in ditches and under dark banks, often several together; this is not always done with a view to seek shelter from the wind, though on some occasions that seemed to be the object. It pitches with the wings fully expanded and close to the ground, just as *P. natalica*; in this position it is less conspicuous than might be supposed, especially when it settles on dark clay, or peaty soil, as it appeared to be fond of doing. Both Dr. Dixey and I saw it orient itself like its congeners, sometimes with adjustment. On one occasion only did I see it close its wings over its back, casting, as a result, a minimum shadow.

Another *Precis*, nearly the colour of the red soil, but more orange in tint, was observed to orient with tail to the sun. This I saw several times but missed; it was on August 18th, on somewhat open ground at the edge of a large banana garden above the Congella woods, Durban. I thought at the time that this was *P. octavia*, Cram., the wet-season form of *P. sesamus*, but it is just possible that it may have been *P. cloantha*, Cram., which I took on the other side of Durban. With the possible exception of this doubtful *Precis* all my remarks about South African butterflies apply to dry-season forms.

Hamanumida dædalus, Fab., is a common African Nymphalid that we only met with on the banks of the Zambesi. We both noted that it usually flies near the ground, on which it settles with the wings closely adpressed to the surface. It occasionally flaps its wings, but as long as they are still it is very inconspicuous, its grey colour approximating closely to that of the sand, the whitish spots

aiding its concealment by breaking up the surface. One was observed to walk about on mud regardless of the sun's direction, but it finally settled down with tail to the sun and wings spread out in the usual way.

[*Abisara* (*Zemeros*) *flegyas*, Cr., a common oriental Erycinid, has a strikingly similar pattern to the last-named Nymphalid, but I do not know what its favourite resting-places are.]

Pyrameis cardui, L. I summed up my observations on this butterfly in Algeria in the following words:—

> I can confidently say that it generally settles with its tail to the sun, though it does not do this with the regularity of *Pararge meone*. I saw two specimens turn their faces to the sun, and saw a third settle twice with its body at right angles, though the third time it settled normally.*

At Durban, on August 21st, I watched this cosmopolitan butterfly orient, but full weight must be given to the following very definite observation of Dr. Dixey's when watching lizards:—

> Ladysmith (North East Defences), Aug. 27th, watched several *P. cardui*, which settled frequently. They would settle at any angle with regard to the sun, but perhaps rather more often with back to it. They fanned their wings, and often shut them up tight (keeping them so for some time) in *any* position with regard to the sun.

This was late in the afternoon, but I do not gather from Dr. Dixey (nor from personal recollection) that the sunlight was feeble, or that there was a strong wind, or that the butterflies were feeding or drinking—all disturbing causes. There can I think be no doubt that the habit of heliotropism is not as fixed in "The Painted Lady" as in many Nymphalids.

Among our notes on heliotropism there are but three references to Pierines. The first is interesting as tending to negative the suggestion that the purpose of heliotropism is to minimize the butterfly's shadow and so aid in its concealment. Dr. Dixey writes:—

> Durban (The Bluff), August 16th. *Teracolus ione*, Godt. (*speciosus*, Wallengr. = *jobina*, Butl.) ♂. When first seen it was settled in the sunshine with wings expanded; then it flew a short distance

* Proc. Ent. Soc. Lond., 1905, p. xxix.

> and settled on a reddish sandy path. Cloud came over the sun, and the butterfly closed up its wings, so that only the hind-wing and tip of the fore-wing were visible.

In explanation of this note Dr. Dixey emphasizes the fact that in the dry-season form of *ione* (= *speciosus*, Wallengr.) the under-side of the hind-wing and the tip of the fore-wing are reddish, hence the tightly-closed attitude is cryptic on red soil. He adds that doubtless when the butterfly contemplates a long stay (as at night, or when the sun goes behind cloud) the closed-up attitude is adopted to take advantage of its cryptic colouring, and not to minimize its shadow.

The other observations were made on *Belenois severina*, Cram., a white butterfly that we found very abundant at Durban.

Dr. Dixey says:—

> *B. severina*, ♂ and ♀; when clouds come over the sun, this species generally settles on a grass stem, and, closing its wings tightly, becomes part of the picture. It certainly generally turns its back to the sun when it settles in sunshine, and then does not often close up its wings.

My note is as follows:—

> *B. severina*, 2 ♀ seen to settle *across* the sun, early in the day. Late in the afternoon many ♂ *severina* seen settled with wings three-quarters open, and tail more or less to the sun; but where much exposed to wind the wings were closed and the head turned to the wind, so as to be almost across the sun.

It is worthy of remark that throughout all these observations of heliotropism, I cannot recall a single case in which an adjustment, or subsequent movement of the butterfly after pitching, tended to throw it out of orientation. Hence it is fair to assume that if the insects had been watched longer after pitching positive results would have been observed in a larger proportion of cases.

But, be that as it may, beyond doubt it is a habit with a number of butterflies, especially Nymphalids, to settle with their backs to the sun. Whether they do this, as Professor Parker supposes, to display their charms to the greatest advantage, or whether the first impulse was

given by the light or warmth of the sun's rays, I am unable to determine, but that in the case of such species as *Pararge megæra* and *Precis clelia* the diminution of the shadow when the wings are closed helps to conceal the butterflies from their enemies I have no longer any doubt.*

Further observations will show how far the habit is general within the families in which it has been observed, and whether it prevails in other families.

The inverted attitude of Lycænids.

In the paper first referred to I drew the attention of the Society to the fact that the curious lobes at the anal angle of the hind-wings of certain Indian Lycænids, to wit species of the genera *Aphnæus, Pratapa* and *Rapala,* are everted so as to be nearly at right angles to the plane of the wing. I showed by a diagram that this eversion of the lobe helped in the suggestion of a head where the tail should be. The original sketch for the diagram was made before I had heard of the "false head theory." † The resemblance would of course be more striking if the Lycænids in question, like so many of the family, habitually rest with the head downwards.

Prof. Poulton discussed the "false head" at some length in his notes to Mr. G. A. K. Marshall's paper on "The Bionomics of South African Insects."‡ Prof. Poulton showed by a reference to Kirby and Spence that the resemblance of the tails of some Lycænids to antennæ was observed early in the 19th century. I venture to give the passage in full:—

> Dr. Arnold has made a curious observation (confirmed by Dr. Forström with respect to others of the genus) on the use of the long processes or tails that distinguish the secondary wings of *Hesperia iarbas.* These processes, he remarks, resemble antennæ, and when the butterfly is sitting it keeps them in constant motion; so that at first sight it appears to

* In the discussion which followed the reading of the paper the President (Mr. F. Merrifield) threw out the suggestion that possibly the object of negative heliotropism might be to enable the butterfly to *see* to the greatest advantage.

† Trans. Ent. Soc. Lond,, 1905, pp. 85, 86.

‡ Trans. Ent. Soc. Lond., 1902, pp. 373–375.

have a head at each extremity: which deception is much increased by a spot resembling an eye at the base of the processes. These insects, perhaps, thus perplex or alarm their assailants.*

Hesperia iarbas at first puzzled me, but it would appear to be the insect now known as *Deudorix* (*Rapala*) *iarbas*, Fab., and the very close ally of *D. melampus*, Cram., one of the insects in which I first noticed the peculiar structure of the anal lobe, about 86 years after Dr. Arnold's observation!

I remember well seeing a Lycænid at rest on a leaf at Solon, on the road to Simla, in October 1903, and was struck by its tails waving about, as I thought at the time blown by the wind.

On March 12th, 1904, the pretty white, black and orange *Talicada nyseus*, Guér., was positively swarming near Kandy. I repeatedly watched it settle with its head upwards and immediately turn about so that its head looked downwards.†

At Mortehoe, June 5th, 1905, Mr. A. L. Onslow and I searched from sundown to dusk for *Emmelesia albulata*, Schiff., in a field adjoining my house; we failed in our search, but incidentally came across a number of *Lycæna icarus*, Rott., asleep on the stems of grasses, etc. Out of fifteen specimens, twelve had the head down, three had the head up.‡

The lobed and tailed Lycænids are not too easy to observe; they are active and commonly fly about the tops of shrubs or small trees; when at rest they are not conspicuous and when disturbed dart swiftly off.

Dr. Dixey noted:—

> Aug. 20. Durban (Botanical Garden). Saw an "amphisbaenoid" *Lycæna* settled twice; the first time horizontally, the second time head downwards. On both occasions the "false head" looked much more like a head than the real one did. There was a constant slight movement of the hind-wings; and a waving of the false antennæ.

* An Introduction to Entomology, vol. ii, p. 255. First Edition, 1817.

† Trans. Ent. Soc. Lond., 1905, p. 126.

‡ When this butterfly first settles on flowers in full sunshine it expands its wings very fully, the primaries being drawn somewhat away from the secondaries.

Unfortunately this specimen eluded capture. Again Dr. Dixey noted :—

> August 16. Durban (The Bluff). Saw a Lycænid settled on the top of a leaf horizontally. The "false head" was much more conspicuous than the real head, which was almost concealed; the real antennæ were quite concealed.

This proved to be *Virachola antalus*, Hopff.; I have a note referring to the same species :—

> A Lycænid boxed off a plant close to the ground; it was sitting with the head downwards, but the "false head" was missing, having been bitten off, probably by a lizard.

Dr. Dixey was more fortunate than I with *Axiocerces harpax*, Fab., since he notes :—

> Sept. 9. Bulawayo, Rhodesia (near the Waterworks). This species was abundant at the catkin-like flowers of a shrub said by Mr. Davey to be a species of *Combretum*. When settled, it closely resembled (at a little distance) the seed vessels, of which many remained on the plant, though the latter was just coming into flower. On a near view, the false head of the Lycænid looks extremely life-like, and is moved about by the butterfly in a most deceptive manner. The species settles either horizontally or head downwards. Attention seems to be drawn to the false head by alternate partial folding and unfolding of the everted margin of the hind-wing, while the butterfly is settled. [Butterfly and seed-vessel exhibited.]

Coming now to my own observations, the "false head" was noted during life in five specimens (all females) of *Argiolaus silas*, Westw., but in none of them was the attitude at rest determined, indeed the insects usually settled high up on the trees beyond my limit of clear vision.

Sept. 10. Matopo, Rhodesia. A male of the beautiful *Stugela bowkeri*, Trim., was twice seen to settle with its head downwards on the catkin-like racemes of the shrub *Sclerocaria caffra*. The "false head" was very obvious. It opened and shut its hind-wings while settled.

Sept. 28. East London (Buffalo River). A specimen of *Phasis chrysaor*, Trim., was seen settled head downwards.

Aug. 14. Durban (near Sydenham "Old Cemetery").

A female *Hypolycæna philippus*, Fab., exhibited a "false head," but was not seen at rest.

Sept. 15. Victoria Falls. A specimen of *Catochrysops malathana*, Bois. (= *asopus*, Hopff.), was seen in the Rain Forest settled with its head downwards.

Sept. 26. East London. Two specimens of *Tarucus telicanus*, Lang., were seen in the Queen's Park sitting horizontally. They were moving their hind-wing alternately *in the plane of the wings*, exactly as I had in the Nilgiris seen a *Lampides* do.*

Tilt to one side, or "list."

This, which I first described as "a sideways attitude," a term not without ambiguity, may be exactly defined as an attitude resulting from a rotation of the insect about its longitudinal axis, as heliotropism results from a rotation about an imaginary vertical axis at right angles to this. Heliotropism corresponds to the movement of a vessel in answer to the helm. Most vessels, independently of wind, waves, or tide, have a tendency to lean somewhat to one side or the other; this inclination is termed by sailors "a list," and, although I am aware that the analogy is not quite close, since the insect may lean at one moment to one side, at another to the other, I shall for brevity term such an inclined or tilted position *a list*.

So far as I know this list was first observed by Col. C. T. Bingham in the case of a *Melanitis* in 1878, but the observation was not published till long afterwards. The extracts from his diary of that year, brought to light by Prof. Poulton, give a most vivid description of some phases of the struggle for existence as it may be seen in a tropical forest. Col. Bingham says:—

> The *Melanitis* was there among dead leaves, its wings folded and looking, for all the world, a dead dry leaf itself. With regard to *Melanitis*, I have not seen it recorded anywhere that the species of this genus when disturbed fly a little way, drop suddenly into the undergrowth with closed wings and invariably lie a little askew and slanting, which still more increases their likeness to a dead leaf casually fallen to the ground.†

* Trans. Ent. Soc. Lond., 1905, p. 118.
† Trans. Ent. Soc. Lond., 1902, p. 363.

Mr. W. H. Edwards, in his *Butterflies of North America*, 1897, quotes Mr. William Couper's observation as to a habit of *Colias philodice*, Godt., in Anticosti :—

> When it alights on a flower, instead of being erect on its feet, it lies sideways, as if to receive the warmth of the sun.

The original passage occurs in the *Canadian Entomologist*, vol. vi, p. 92, 1874; if therefore this be truly such a list as is under discussion, Mr. Couper deserves the credit of having first observed it, but at present I am doubtful on the point.

In the summer of 1903, at Mortehoe, Dr. Dixey and I observed a like habit in *Satyrus semele*, L.; and later in that year (and in the following) I found that other British Satyrids, such as *Pararge ægeria*, L., and *Megæra*, L.; *Epinephele jurtina*, L., and *hyperanthus*, L., had a similar habit, though less marked. The butterflies when confined in a box were seen to assume the list more often in sunshine than in shade.*

In India, in the late autumn of 1893 I noted the same habit in the Satyrines *Hipparchia parisatis*, Koll., and *Aulocera swaha*, Koll.†

On the voyage out to South Africa the usual call at Madeira gave us little more than a glimpse at its butterflies. The local race of *Satyrus semele*, L., was common on the Caminho do Meio at an altitude of about 800 ft., and Dr. Dixey has this note :—

> Settled on the ground, low herbage, walls and tree-trunks. The fore-wings are depressed with a snap as in the English *semele*. Two were specially noted settling in sunshine (not strong) both turned head to sun and listed—one to port and one to starboard.

My note is :—

> A specimen seen settled face to sun, list 30° to starboard.

It was of course only to be expected that on the fifth day from leaving Southampton we should both use nautical phraseology.

South Africa contributed little to increasing our knowledge of the "list." The genus *Pseudonympha*, somewhat suggestive of *Erebia*, is characteristic of Cape Colony; at

* Entomologist's Monthly Magazine, 1905, p. 44.

† Trans. Ent. Soc. Lond., 1905, pp. 64, 135.

East London I observed several *P. cassius*, Godt., at rest, but did not see any list.

Mycalesis safitza, Hew. Though I took many odd specimens of this dingy butterfly, I never found it really common, and have but two notes of its resting attitude:—

Berea, near the hotel, Aug. 14th, seen to settle in the shade, wings upright.

And,

Congella, Aug. 18th. This species does not appear to orient: a slight list *away* from the sun, but sun not very bright at the time of observation.

Dr. Dixey, however, in the case of this butterfly obtained more positive results:—

Durban (Botanic Garden), *Mycalesis safitza* has a very strong list when settled in the open; it may be to right or left in the same individual.

Durban (Botanic Garden), saw *Mycalesis safitza* settled on bare ground; it had a strong list to the left. Saw it fly and settle in strong sunshine; once with its back to the sun, with list to left; once with head to sun, right list; once at right angles to sun, throwing a broad shadow.

It would therefore seem that *Mycalesis safitza* may be included among the Satyrs with a list, but this does not appear to help concealment by diminishing the shadow, as I suggested would be the case if the list were towards the sun.*

Near Darjiling, in 1903, I observed a slight list in *Mycalesis indistans*, Moore. And in Japan, in 1904, the fine Satyrid, *Blanaida goschkevitschii*, Mén., had a striking list.†

General.

That the term "Rest Attitude" is used in this paper very loosely I am well aware. A butterfly may be conceived as resting in several stages. First, it may settle to feed. *Sphinx* feeds on the wing; many a *Papilio* settles on a flower to feed, but flutters while sucking the honey, this, *e.g.*, is the habit of *P. erithonius*, Cr., *P. hector*, L., and *P. dissimilis*, L. Thus in Ceylon I found that the best way of distinguishing the last-named from the Danaids

* Trans. Ent. Soc. Lond., 1905, p. 136.

† *Loc. cit.* pp. 94, 135.

which it mimics so closely was by this fluttering. Many moths, notably *Plusia*, are intermediate between *Sphinx* and *Papilio* in this respect. The vast majority of butterflies feed with their wings still, in some cases more or less widely spread out, in others closed over the back. The Skippers of such genera as *Syricthus*, *Pamphila* and *Gegenes* settle with the hind-wings horizontal, the fore-wings nearly vertical, but other Skippers, such as *Baoris* and *Eretis*, settle with the wings fully spread out.

Again, butterflies often rest from flight on the ground, on the upper-side of leaves, or on tree-trunks. A few Skippers, such as *Celænorrhinus*, *Caprona* and *Pterygospidea* (*Tagiades*), settle on the *under* side of leaves, with their wings spread like Geometers.

Such a state of rest is more reposeful than that first described, but in many species it is varied by occasional closing and re-opening of the wings; or in some Lycænids by curious horizontal movements of the hind-wings only.

A third stage is when they rest for a long time in one position, then the wings are usually raised over the back (even in the case of *Hesperia*, etc.) and often the fore-wings are withdrawn within the hind-wings. In some species, notably *Euchloë* and *Synchloë*, when the creature is at rest the hind-wings do not approach the stem on which it sits, but the abdomen is elevated some 30°–40° and quite concealed between the hind-wings. This attitude greatly increases the similarity of the insect to a leaf. [Exhibited.]

The actual habits of butterflies when asleep are but little known, the great majority almost certainly close their wings over their backs, but some of the larger Skippers, such as *Caprona*, etc., probably sleep with them spread out like Geometers. Certainly our common Skippers, *Pamphila sylvanus*, Esp., and *P. linea*, adopt the usual butterfly attitude, but many years ago Mr. Roland Trimen called attention to the fact that *Nisoniades tages*, L., sleeps with the wings inclined so as to form a roof, like many *Noctuæ*.* I noted in South Africa that in some Skippers the posterior third of the hind-wing is curiously plaited when at rest, thus again resembling *Noctuæ* and other moths. This may be well seen in the big *Rhopalocampta keithloa*, Wallengr., and *Pterygospidea flesus*, Fab., as well as in the little *Gegenes zetterstedti*, Wallengr. (= *hottentota*, Latr.).

* Barrett's Lepidoptera of the British Islands, vol. i, p. 309.

Intimately bound up with the attitude at rest is the question whether or no insects select resting-places of a character likely to make the most, so to say, of their cryptic colouring.

Many years ago the late Mr. Geo. Norman and myself took a lot of *Polia chi*, L., at rest close to the hydropathic establishment at Forres, and we were much puzzled by the fact that while many were taken on whitewashed walls, where they were difficult to detect, quite as many were found resting on dark tree-trunks and could be easily seen at many yards' distance.

Mr. Hamm has made some striking observations tending to an affirmative answer to this question.* In the Baghi Forest, near Simla, I was struck by the way in which the conspicuous yellow *Terias hecabe*, L., disappeared when it settled on a low shrub with oval leaves fading to a yellow tint, the rounded form of the wings aiding its concealment.† But the most convincing case that has come under my own observation was a large yellow butterfly (I had no net but think it was probably *Catopsilia catilla*, Cr.) which I saw in the garden of the University of Bombay. I saw this settle again and again, invariably in a small shrub with yellow leaves. The very conspicuous fly would vanish suddenly, and it was only after several attempts that I succeeded in getting a glimpse of it when settled, so strong was the protective resemblance.‡

In an analogous S. African case I am able to supply fuller details:—

Eronia cleodora, Hüb., is a common Natal Pierine. Few insects are more conspicuous in the net than this beautiful fly with its combination of creamy-white, jet black and deep yellow, and one might well wonder how it could possibly manage to hide itself. I watched it settle once upon the ground, and strangely enough it was not conspicuous when its wings were closed and the brilliant yellow of the under-side was fully exposed to view. Then I twice saw it settle on grass; when the wings were half open it was very conspicuous, but when they were closed it was far otherwise. Four times I saw specimens go to

* Proc. Ent. Soc. Lond., 1904, p. lxxv, and Proc. Ent. Soc. Lond., 1905, p. lxxiii, and the interesting discussion following the latter paper.

† Trans. Ent. Soc. Lond., 1905, p. 69.

‡ Trans. Ent. Soc. Lond., 1905, p. 107.

rest on the leaves of the Acanthaceous under-shrub, *Isoglossa woodii,* Clarke [= *Ecteinanthus origanoides,* T., and of J. Medley Wood's *Natal Plants,* vol. i, plate 22], called by the natives *u-Bomaan,* which forms the bulk of the undergrowth of the scrub on The Bluff, at Durban. It hung more or less downwards with its wings closely shut up, in which position its general shape was not unlike that of a leaf, while its colour, yellow blotched with purplish-brown, had a striking resemblance to the many yellow, eaten and blotched leaves upon the shrubs. The brilliant insect lost itself in its surroundings, although this was not a case of definite leaf mimicry as in *Kallima* or even in *Precis.* A rough-coloured sketch made at the time gives (apart from artistic shortcomings) a faithful representation of some of the leaves, though the yellow colour hardly shows by artificial light. [Sketch and butterflies exhibited.]

Dr. Dixey has a note which confirms the above :—

> The Bluff, Durban, Aug. 16. *Eronia cleodora,* ♂, observed to settle near leaves which, turned yellow and showing slits and circular holes, closely resembled its under surface.

Mr. J. Medley Wood, the Director of the Natal Botanic Gardens, kindly writing to give me the name of the plant, says that the food plants of *E. cleodora* are *Capparis zeyheri,* Turcz, and *Niebuhrria pedunculosa,* Hochst.

Perhaps the most tropical-looking butterfly that we met with in S. Africa was the large Nymphalid, *Salamis anacardii,* L.; nearly 4 inches across the wings, greenish-white, with a strong pearly lustre, it is a very beautiful creature. Its flight is very weak. Mr. A. D. Millar of Durban said that it was fond of resting in a particular tree or shrub with glaucous leaves.

Dr. Dixey has a note :—

> Sydenham, Durban, Aug. 15. Watched *Salamis anacardii,* L. It flew in a slow, flappy, undecided way from side to side of the road, settling each time for a second or two on a tree. Presently it reached a tree whose leaves were about the same size as the *anacardii* when resting with wings over its back. Here it settled, beneath a cluster of leaves, being fully exposed to view and yet well concealed. It remained quiescent until forcibly disturbed.

I have no manuscript note, but remember well that before Mr. Millar mentioned the fact of *anacardii* having a proclivity for such trees, I saw one take refuge in a shrub, or small tree, having large glaucous leaves; and I am almost sure that I beat another specimen out of the same kind of tree, but I failed to see the insect at rest.

Writing of *Colias philodice*, Godt., Mr. W. H. Edwards says: "On marigolds and brilliant single zinnias they delight to pasture, for they have a keen sense of colour. I have known one of them alight on an amethyst in a lady's ring, after hovering about its owner so persistently as to attract attention, and it rested some seconds." *

Mr. S. H. Scudder quotes the following interesting observations on the same butterfly, *Eurymus philodice*, Godt. (called in America "the sulphur").

"Dr. Minot once observed that when searching for its honied food the butterfly most frequently alighted on yellow flowers; and Dr. Packard has recorded that in a field where white asters and yellow golden rods were abundant the yellow sulphur butterfly visited the flowers of the golden rod much oftener than those of the aster, while the opposite was the case with *Pieris rapæ*." † Again, in another place, he says, "and Jenner Weir has noticed how the white butterflies settled on the variegated leaves in his garden." ‡

The preference shown by the two butterflies for golden rod and asters respectively is interesting. These genera, highly characteristic of North America, are closely allied *Compositæ*. On the other hand, *P. rapæ* was introduced into the country in 1860 or thereabouts.

Dr. Dixey has kindly placed at my disposal the notes of a number of his observations on common English butterflies which have a bearing upon the point under discussion.

> 1897, July 12, Mortehoe. *S. semele*; flight more rapid than that of *H. janira*; it is also more apt to settle. When settling, chooses if possible a bit of grey rock or bare pathway. Sits with antennæ expanded and projecting forwards, body raised somewhat on legs. At first settling, eye-spot of fore-wing generally just appears; then by a definite

* *Butterflies of North America*, vol. ii, 1897, *sub philodice* (not paged).

† *Butterflies of New England*, 1889, vol. ii, p. 1124.

‡ *Ibid.*, vol. ii, p. 1102.

sharp movement the wings are further closed, and the eye-spot is visible no longer. *H. janira* as a rule shows eye-spot while resting [*i.e.* during temporary rest in daytime].

July 12. Mortehoe. Watched *G. brassicæ*, ♂, resting on a *bramble* flower; wings closed so that the tip was the only part of fore-wing visible.

July 13. Mortehoe. Watched *V. urticæ* at rest, quite 5 m. without stirring. It raised its wings but did not completely close upper-wing behind lower, so leaving a (roughly) equivalent triangle of upper-wing showing, including the whole of the dark costal mark.

July 14. Mortehoe. *H. hyperanthus* at rest shows eye-spot of fore-wing, like *H. janira* [*i.e.* at *temporary* rest].

At 8.25 p.m. saw *H. janira* settle down to rest. Eye-spot of fore-wing quite concealed.

At 8.35 p.m. saw *P. sylvanus* resting. Wings turned up flat over back, not in characteristic "skipper" attitude.

July 15. Mortehoe. Saw *H. janira* settled (in sunshine) with eye-spot of fore-wing quite covered.

Saw *G. napi* settled with about half of discoidal cell of fore-wing showing. Afterwards saw one with only tip of fore-wing showing.

August 11. Mortehoe. *P. megæra* at rest does not shut up like *S. semele* (at least not during temporary rest in hours of flight). It usually sits with wings almost completely expanded.

Aug. 12. Mortehoe. Saw G. *rapæ*, ♂, settled, towards dusk (nearly 8.0 p.m.), on a *bramble* leaf in a hedge. Wings vertical. On left side none of fore-wing showing but bare apex. On right side a large part of fore-wing showing. On careful examination this was found to be due to the fact that the right hind-wing was split, and the fore-wing had got caught in the cleft, this preventing complete closure on that side.

Aug. 13. Mortehoe. Saw *H. tithonus* at rest; wings entirely closed up. A cloudy evening.

Aug. 23. Watched whites in Sandy Lane. When settled for rest they look very much like turned-back leaves of *bramble*, near or on which they are

fond of settling when meaning to remain settled for some time. In bright sunshine they often settle on flowers with wings partly or entirely spread, but in dull windy weather like this morning's, they are apt not to fly unless disturbed, and then to settle again very soon. I disturbed one *G. rapæ*, ♂, eight times and watched it settle again seven times. Five times it settled on *bramble*, although there was plenty of other vegetation. Of the other two times, the first was on the head of a yarrow, and the second on another low plant close to a spray of *bramble* with recurved leaves, which it closely resembled at a little distance.

Aug. 27. Saw *G. brassicæ*, ♂, settle twice on *bramble* and close up its wings.

1898. Sept. 7. Have several times lately, when coming up Sandy Lane at dusk, seen *G. rapæ* settled, apparently for the night. Generally on *bramble*, wings quite closed. They will allow themselves to be seized with fingers or forceps, but then generally wake, and fly off if let go.

Aug. 8. Observed that *L. icarus* is fairly well protected (*i.e.* concealed) on heads of bramble-blossom when wings are closed.

1898. Aug. 9. Mortehoe. Saw *H. tithonus*, ♀, settled on a bramble-leaf in sunshine, eye-spot showing. Cloud came over the sun, and *tithonus* shut up, eye-spot becoming invisible. Opened again when cloud passed.

This observation was referred to by Professor Poulton. [Trans. Ent. Soc. Lond., 1902, p. 372.] Compare the observation on *Teracolus ione*, p. 104, 105, *supra*.

1904. Highcliff, Hants. Aug. 8. Watched *G. brassicæ*, ♂, settle down for the night about 7.15 p.m. After much fluttering about the stems of tall grasses, it came to rest on a head of hawkweed in the *pappus* condition, and remained there with wings hanging downwards and closed over its back.

Recently M. J. Th. Oudemans has published an interesting memoir entitled "Etude sur la Position de Repos chez les Lepidoptères." *

* *Verhandelingen der Koninklijke Akademe van Wetenschappen.* Vol. x, No. 1. Amsterdam, 1904. (Read at Berlin, International Congress of Zoology, August 1901.)

M. Oudemans only treats of one aspect of the subject which he deals with exhaustively by numerous observations on living specimens of all the chief groups of Macrolepidoptera. His conclusions may be shortly expressed, almost in his own words, thus:—Lepidoptera have a sleeping-dress; this dress forms a harmonious whole. The different parts which contribute to form the whole dress harmonize in their colours and usually in their patterns. The parts of the insect which are concealed during rest are quite frequently strongly contrasted in colour or pattern to the exposed parts. M. Oudemans explains the facts by the influence of exposure to light.*

M. Oudemans does not allude to the points chiefly dealt with in this paper, but one of his beautiful photographs shows *Chrysophanus phlœas*, L., sitting with abdomen tilted up at an angle of about 45° to the thorax, as I have shown in the specimen of *Euchloë belemia*, Esp., exhibited. He does not however call attention to its peculiar attitude. That it must greatly increase the resemblance to a dead leaf is obvious enough.

In bringing this somewhat disconnected paper to a close I venture to make a remark which has a wide bearing on the whole question of cryptic and mimetic resemblances.

Butterflies are most numerous and varied within the tropics. In the tropics the length of daylight varies much less than in temperate zones, and is many hours shorter than in the temperate summer. At the equator the sun is above the horizon for twelve hours every day; at the tropics the sun is above the horizon from a minimum of $10\frac{1}{2}$ hours to a maximum of $13\frac{1}{2}$ hours.

But although the sun is visible for these long periods, not so the butterflies. Very few comparatively are to be seen on the move before 9 a.m., and few after 3 p.m.†

Now my point is that tropical birds, lizards, and other insectivorous animals have some six hours of full daylight in which to hunt butterflies, when the latter are more or less at rest. This is a fact not usually allowed for in the discussion of questions of protective resemblances or mimicry, but it emphasises the need for concealment.

* Compare Dr. M. Standfuss, *Die Beziehungen zwischen Färbung und Lebensgewohnheit bei den Palaertischen Grossschmetterlingen* Vierteljahrsschrift der naturforsch. Gesellschaft in Zürich. XXXIX Jahrgang, 1894. (Read November 6, 1893.)

† Mr. A. D. Millar says that in the afternoon female butterflies are relatively more commonly seen.

XXIV. *Synepigonic series of* Papilio cenea (1902–3) *and* Hypolimnas misippus (1904), *together with observations on the life-history of the former.* By George F. Leigh, F.E.S. With notes by Professor Edward B. Poulton, D.Sc., F.R.S., and an Appendix by Roland Trimen, M.A., F.R.S.

[Read June 1st, 1904.]

Plates XXXI and XXXII.

I. *Observations on the life-history of* Papilio cenea.

On September 18, 1902, I took a male of *Papilio cenea* in copulâ with a female of the *cenea* form which is commonest in Natal, viz. that which possesses *white* spots on the fore-wing. Having previously discovered the food-plant, I decided to try and obtain eggs. I placed in a large paraffin tin a small example of this plant, and by its side a vase with several of the flowers on which the butterfly feeds, covering all in with mosquito netting. The female *cenea* fed on the flowers, and lived for five days. I then carefully examined the plant and found 90 eggs upon it, but not one on the flowers or the sides of the tin. The eggs are white and very small; they are laid upon both sides of the leaves and upon the small stems of the food-plant. The larvæ began to hatch on September 29, only three of the eggs proving barren. The young larvæ are nearly black in colour, with white on the last segment. The first ecdysis occurred on October 3–5, when 13 of the larvæ died. They were then transferred to another tin with fresh food-plant. In the second stage they are chocolate and white. When not feeding, the larva rests upon a slight web spun over the central part of the leaf. The second ecdysis occurred on October 8–11, after which 70 living larvæ were counted. The colours were as in the second stage, save that the chocolate was of a paler shade. The larvæ fed well and grew rapidly, the third ecdysis taking place on October 13–16. An immense change in appearance is now manifest; for the larvæ of the fourth stage are blue-green, beautifully variegated with white, of which the amount varies greatly in different individuals. All the larvæ passed this ecdysis safely, but four were killed for preservation. The last ecdysis occurred between

October 18 and 26, some of the larvæ lagging behind the others in their rate of growth. Another change is now witnessed; for the larvæ of the last stage are blue-green (exactly matching the food-plant), with small orange spiracular spots and two blue spots invariably present on the third segment, other segments being sometimes similarly marked.

The larvæ began to attach themselves preparatory to pupation on October 27, and continued to mature for about a fortnight. The situation generally selected was a part of the food-plant where a leaf had been eaten completely away; although some pupated upon the netting and some upon the sides of the tin. Six larvæ were killed for preservation, and a certain number failed to pupate; but I obtained 56 healthy chrysalides, all of which were green, exactly matching the shade of the leaves of the food-plant.

The imagines began to emerge November 7, and continued to come out up to the 22nd.

It is often stated that the males of Lepidoptera tend to emerge before the females, a conclusion which my experience by no means confirms. In this case the first two which emerged were both females. I did not keep an account of the emergences after this, but the largest number to appear in one day was 11, of which 7 were females. According to my usual experience with bred specimens there were a larger number of females than males, viz. 27 to 18. The 11 remaining pupæ either dried up or produced cripples.*

All the specimens were smaller than those of the same broods captured in the wild state, and this I trace to the artificial conditions inseparable from the described method of breeding.

In nature the females are far rarer than the males; one might probably see twenty-five of the latter to one of the former. The female, I believe, flies but little in the open except when engaged in oviposition. Only two or three eggs are laid on each plant, and those growing under trees or otherwise in the shade are the most frequented. The

* In future work of this kind when the material bears upon problems in heredity of the utmost importance and complexity, every dead pupa and every crippled specimen should be carefully preserved; for the lens would certainly reveal the sex, while dissection would in many cases reveal the variety.—E. B. P.

larvæ are invariably found on the lower parts of the plant, as near to the ground as possible. They are fairly easy to detect in the chocolate and white stages, but in the last they are the hardest larvæ to find of any with which I am acquainted. The method which I have found to be the best is to knock the plant with the hand, when the disturbed larvæ evert their crimson prothoracic scent-glands. They are then either seen or their presence is revealed by the smell. The pupæ are even harder to find than the larvæ.

My experience with the rare *trophonius* form, mimicking *Limnas chrysippus,* is somewhat limited, but I have succeeded in breeding four examples from captured wild larvæ. I have observed that its pupæ are quite different in colour from those of the other forms. With this exception, the pupæ of all the varieties of *cenea* are simply green, and do not vary in appearance, like those of many of the *Papilioninæ.* The pupa of the *trophonius* form of female was at once distinguished, in the examples which have come under my notice, by a number of brown lateral markings. Of course I am not referring to the usual changes before emergence, when the pattern of the wing can be recognized beneath the thin pupal cuticle, and when, in the case of *cenea,* the male can be easily distinguished from the female.

II. *The Synepigonic Group bred in* 1902 *from a pair of* PAPILIO CENEA (CENEA *form of female*).

It has been already stated that 27 females and 18 males were bred from the parents represented on Plate XXXI, Figs. 1 and 2.

A. *The Female Offspring.*

Not a single example of the brown *trophonius* form, mimetic of *Limnas chrysippus,* appeared among the 27 females, but three were of the *hippocoonoides* form (two of these are represented in Plate XXXI, Figs. 7 and 8) mimicking *Amauris dominicanus.* All the rest were the *cenea* form (four of these are represented in Plate XXXI, Figs. 3–6) mimicking *Amauris echeria.* Of the *cenea* forms three possessed buff-coloured spots on the fore-wing; while probably the whole of the remaining specimens, 21 in number, were the variety which is commonest in Natal, and possesses white spots on the fore-wing, mimicking

A. albomaculata and the examples of *A. echeria* which converge towards it. Two or three cripples were liberated, but they were certainly *cenea* forms, probably white-spotted.

I feel confident that no wild eggs or larvæ were accidentally introduced with the food-plant, but cannot be equally sure about the pupæ. I was not then very familiar with these remarkably cryptic forms, and it is possible that one, or even two or three, may have slipped in unperceived.

Comparison of the Individuals of the 1902 *Synepigonic Group of* Papilio cenea. By E. B. Poulton.

A considerable part of the 1902 material had been dispersed before the present paper was written; but I have made a careful examination and comparison of the whole of the remaining specimens recently presented to the Hope Department by Mr. Leigh. These consist of 8 females (6 *cenea* forms and 2 *hippocoönoides* forms) and 6 males. In the first place it appears possible that the presence of one male and two female (white-spotted Natal *cenea* forms) specimens, which are distinctly larger than the others and also larger than the parents of the group, may perhaps be accounted for by the accidental introduction of wild pupæ with the food-plant.

When the 6 females of the *cenea* form were minutely compared it was apparent that they are not divided into two distinct categories respectively characterized by the buff tint and by the white appearance of the five chief spots of the fore-wing. There was, on the other hand, the most perfect gradation of the one form into the other.

The five chief spots may be indicated by numbers as follows:—

(1) The largest spot, of an oval form, placed below the cell, between the 1st and 2nd median nervules.

(2) A spot, of which the form is usually oval, placed beyond the end of the cell, between the 2nd radial and 3rd median nervules.

(3) A roundish or oval spot, placed beyond the end of the cell, between the 5th sub-costal and 1st radial nervules.

(4) A roundish or oval spot, with its outer border generally marked by a concavity. When the latter curve is strongly marked the spot becomes crescentic (as in Plate XXXI. Fig. 4) or reniform (as in Fig. 3). This spot

is placed beyond the end of the cell, between the 3rd and 4th sub-costal nervules.

(5) The irregular spot within the cell.

The transition from a condition, resembling the female parent, in which the five chief spots of the fore-wing are white, towards one in which they are buff, is clearly seen in the following comparison of the 6 female specimens in this synepigonic group.

I. The largest specimen, unfigured. All five spots white except the edges of (1). The buff tint is especially pronounced on its inner marginal edge —a tendency often manifest in specimens in which this spot is almost entirely white.

II. A slightly smaller specimen, unfigured. (1) *very* pale buff, (3) still paler. The latter not uniformly tinted. At a little distance both spots appear to be white.

III. The specimen represented on Plate XXXI, Fig. 3. (1) distinct buff, (3) and (5) *very* pale buff, the tint of (3) being even fainter than in the specimen last mentioned. At a little distance all spots except (1) appear to be white.

IV. The dwarfed specimen represented in Fig. 5. The condition is similar to that described in No. III, except that spot (3) is of a very slightly deeper shade. Nevertheless, at a little distance all the spots appear to be white except (1).

V. The specimen represented in Fig. 4. (1) buff of a slightly deeper shade than in specimen No. III. (3) very distinct buff. (5) outer half of the area distinct buff. The lens shows traces of the same tint on (2) and (4), but to the eye these two spots and the costal (or inner) half of (5) appear to be white.

VI. The much-dwarfed specimen represented in Fig. 6. All spots except (4) buff, with an appearance of additional depth of tint caused by the over-spreading of dark scales—an encroachment of the ground-colour of the wing. (4) appears to be white or *very* pale buff at a little distance, and is much less overspread than the others. The depth of the shade of buff is most marked in (1), then in (2), (5), and (3) in this order.

The dwarfed condition of specimens 4 and 6 is worthy

of attention, inasmuch as it is possible that the shock of abnormal conditions may have favoured slight reversion to a relatively ancestral form. It has been similarly observed that a set of abnormally small specimens of *Limnas chrysippus*, var. *dorippus* (= *klugii*), from Machakos Road, British East Africa, exhibited an unusual amount of reversion towards the type form of the species (Trans. Ent. Soc., 1902, p. 483).

The very distinct di- and trimorphic forms of some of the chief Ethiopian mimics of *Limnas chrysippus* are still connected by transitional varieties which have been lost or are at any rate unrepresented in the primary model. Hence it has been argued that "*A Study of Mimetic Forms may enable us to reconstruct the Lost Stages through which the Older Model has passed*" (Trans. Ent. Soc., 1902, p. 482). In this case also it is seen that uninterrupted transition obtains between the *cenea* forms of the female mimic with white spots on the fore-wing and those with buff. In the Danaine models, on the other hand, there is a sharp break between the white-spotted *Amauris albomaculata* and the buff-spotted forms of *A. echeria*, and even between the white and the buff varieties of the latter species. It is in every way probable that here too the transition which is witnessed in the younger mimic formerly existed, but has finally disappeared in the older model—viz. the two forms of *Amauris echeria*. As regards the origin and history of the differences between the two *species* which act as models—viz. *albomaculata* and *echeria* —the interpretation is at present less clear and convincing.

It is unnecessary to describe the two *hippocoonoides* forms of females. A glance at Plate XXXI, Figs. 7 and 8, will show that the pattern is typical, although the size is abnormally small, especially in one specimen (Fig. 7).

A careful comparison of the male individuals in the 1902 synepigonic group leads to equally interesting results. In this investigation I have confined my attention to the most distinctive feature of the pattern—the inner black band of the hind-wing. It will be seen that this marking is subject to remarkable individual variation in males of one family. At the same time it is the character by which the males of certain forms of the *Papilio dardanus* (*merope*) group are usually discriminated. It will be convenient to describe the appearance of the band in the best-known forms, before proceeding to record

the individual differences between the males of a single family of the same form.

The inner row of black patches on the hind-wing of the ancestral *Papilio meriones* from Madagascar is usually broken by two gaps, one between the 2nd sub-costal and the discoidal nervule, the other between the 2nd and 3rd median nervules. The former may be conveniently spoken of as "the costal gap," the latter as "the inner gap." The costal gap is often partially and sometimes completely closed by a sickle-shaped black marking, with its concavity directed inwards. The broadened base of this marking, present in all the specimens I have examined, arises from the black patch placed between the discoidal and 3rd median nervules. The inner gap is often partially filled by a detached black spot. This description applies to females as well as to males, although the black markings are more often developed and tend to be more completely developed in the gaps of the first-named sex.

The male of *P. dardanus* (= *merope*) from the West, or rather the tropical forest (for it extends at least to the N.-E. shores of the Victoria Nyanza), is very similar to that of *meriones* in the characters here described; but the gaps are on the whole wider and less frequently occupied by spots. The base of the sickle-shaped marking is, however, generally present. In the male of *P. antinorii*, from Abyssinia, the band is even more interrupted than in *merope*.

In the male of the Eastern and Southern *P. cenea* both gaps are usually filled, and a continuous broad black band extends from the inner to the costal margin, nearly parallel with the general trend of the hind-margin. This band, which is by far the most prominent feature of the hind-wing, tends to reach a fuller development in males from the northern section of the insect's range along the Eastern coast as compared with males from the southern section. Nevertheless, even in the specimens with the heaviest markings the position of the inner gap is clearly indicated by a bay on the hind marginal border, rendering the band narrowest at this point. Occasionally, too, even in specimens from Mombasa, a small yellow spot, or scattered yellow scales invading the band from within, mark the position of the costal gap.

In examples from Natal and the Southern part of Cape Colony the gaps are far more frequently and more fully

indicated. The mark corresponding to the sickle is not bent in a curve but at a right angle.

Meriones and *antinorii*, with non-mimetic females resembling the males (also accompanied by mimetic females in the case of *antinorii*), are certainly ancestral as compared with other forms of the group, and therefore it is almost equally certain that the interrupted black submarginal band of the male is ancestral as compared with the continuous band.

The submarginal bands of the 6 males of the 1902 synepigonic group may be briefly compared as follows:—

Specimen 1.—Costal gap distinctly indicated, but closed by a broad sickle. Inner gap indicated by narrowing of band.

Specimen 2.—Costal gap closed by a narrow sickle. Inner gap as in 1, but slightly less narrow.

Specimen 3.—Costal gap open: inner much narrowed.

Specimen 4.—Costal gap closed by a narrow sickle: inner still more narrowed than in 3.

Specimen 5.—Costal gap indicated only by a slight narrowing (less marked than in any other specimen). Inner gap open, with faint traces of narrow band.

Specimen 6.—Costal gap closed by a narrow sickle: inner open, with a small detached spot midway between the nervules which form its boundaries. This specimen is much dwarfed, and it is possible that the marked discontinuity of the band may be due to reversion, brought about by the shock of abnormal conditions.

The appearance of the band in the male parent is clearly indicated in Plate XXXI, Fig. 2. The costal gap is closed by a sickle intermediate in breadth between those of the above-described specimens 1 and 4. The inner gap, only preserved on the left side, is more freely open than in any of the offspring.

The male parent (see Plate XXXI, Fig. 2) is, I believe, somewhat less heavily marked in this respect than is usual in the Southern form of *P. cenea*, and the offspring are upon the whole also less heavily marked. At the same time, they exhibit very interesting individual variations, never quite reaching the open condition of the inner gap in the parent, but in half of the examples going beyond their parent in the degree of development of the costal gap.

The evident hereditary tendencies displayed in these males, together with their marked individual differences, are of especial importance in relation to the study of the wonderful series of modifications which are encountered when we trace the allied forms of this remarkable *Papilio* from the coast of British East Africa, westward into Uganda, and north-westward into Abyssinia. In any such investigation we must reckon with the fact that individuals of the same synepigonic group are now proved to exhibit great variation in the degree of continuity of the most prominent feature in the hind-wing. E. B. P.

III. *The Synepigonic Group bred in* 1903 *from a captured female of* PAPILIO CENEA (TROPHONIUS *form of female*).

I succeeded in capturing one of these rare forms of the female in the neighbourhood of Durban on September 18, 1903. Both wings on the right side were slightly but distinctly smaller than those on the left (see Plate XXXI, Fig. 9). From this butterfly only seven eggs were obtained, and only five larvæ successfully reared. It is certain that the experiment was not in any way vitiated by the introduction of wild eggs, larvæ, or pupæ. Two of the larvæ pupated on October 19, one on October 20, and two on October 23. The butterflies emerged on the following dates:—

Nov. 2. 1 ♀ *cenea*-form (Plate XXXI, Fig. 10).
„ 3. 1 ♂ (Fig. 14).
„ 4. 1 ♂ („ 13).
„ 6. 1 ♂ („ 12).
1 ♀ *cenea*-form (Fig. 11).

Thus both the female offspring of the rare *trophonius* form were examples of the commonest of all Natal varieties.

Comparison of the Individuals of the 1903 *Synepigonic Group of* PAPILIO CENEA. By E. B. POULTON.

The first of the females to emerge is rather smaller than the other (Plate XXXI, Fig. 10). Spot (1) is unusually small for an insect of this size (compare Figs. 3, 4, and 11), being not only greatly reduced by encroachment of the ground-colour but also overspread with scattered dark scales. The specimen is a white-spotted variety very similar to female II. of the 1902 group. The appearance of spot (5) is, however, the same as in female III.

The second female is represented on Plate XXXI, Fig. 11. It is seen that the left hind-wing is somewhat crippled. The specimen is a typical white-spotted form of *cenea*, similar to female I. of the 1902 group, but having an even smaller development of the buff tint on the inner marginal border of spot (1).

It is unnecessary to describe the three male offspring in detail; inasmuch as the form of the band and the development of the gaps are clearly shown in Plate XXXI, Figs. 12–14. It is obvious, on a glance at the figures, that the inner gap is open in two specimens (Figs. 13 and 14), and only interrupted by a faint imperfect band in the third (Fig. 12). The costal gap, although not entirely open in any specimen, is strongly indicated in all three.

The condition of the band in the males of these two groups raises the question, which was previously suggested (see pp. 681, 682) by the dwarfed female represented in Fig. 6, as to whether any of the conditions associated with breeding from the egg in confinement may not favour reversion towards the more ancestral form of *meriones* and *merope*. It must be repeated that this is but a conjecture which would require the examination of a longer series of captured specimens and a far larger number of bred specimens in order to confirm it. It is, however, suggested as a possibility in certain cases by a study of the limited amount of material at my disposal.

The proportion of the various forms of the female in these two groups of offspring (1902 and 1903), and especially the absence of *trophonius* from both, raises an interesting question as to their proportion in nature. Existing records do not enable us to arrive at certain or exact conclusions, but the following data are sufficiently in agreement to justify a rough estimate.

Mr. G. F. Leigh informs me that in a good season in the neighbourhood of Durban, from 25 to 30 males might be met with in a single day; but some of these would be the same insect encountered more than once. During the last season (1903) Mr. Leigh did not see more than 30 females altogether, and of these 2 were the *trophonius* form. Inquiring the experiences of others in the same period of time, he heard of only one other specimen of the latter variety.

Mr. G. F. Leigh recognizes a second form of *hippocoonoides* with "chalky-white" markings similar to, and, as

he thinks, mimetic of *Euralia wahlbergi*. This Mr. Leigh describes as rarest of all the forms of *cenea*. It has been already pointed out that in certain respects the *hippocoonoides* form of *cenea*, and the *hippocoon* form of the Western *merope* respectively, resemble their Nymphaline co-mimics *Euralia wahlbergi* and *E. anthedon* far more closely than the primary models *Amauris dominicanus* and *A. niavius* (Trans. Ent. Soc. Lond., 1902, p. 486, *footnote*). The existence of this chalky-white form indicates an interesting approach towards the co-mimic in another character.

Mr. Guy A. K. Marshall, in sending an estimate of the proportionate occurrence of the three chief forms of the female *cenea* in Natal, warns me that he is only giving a very general impression based on a limited and now long-past experience. His estimate is as follows :—

Cenea	10
Hippocoonoides	4
Trophonius	1
	15

Mr. Roland Trimen, F.R.S., wrote as follows :—

"November 23, 1903.

"At Knysna (where I was out in the district almost every day for about eight months) I saw only 2 *trophonius*, both of which I captured. In Natal, I saw no *trophonius* during four months of almost daily collecting; I have received at long intervals 3 examples from there—1 taken *in copulâ*. I also received from Plettenberg Bay (Knysna District) 3 examples, 1 from East London, and 1 (a variety with fulvous instead of white sub-apical bar to fore-wing) from Bathurst;—all in Cape Colony. *Hippocoonoides* I never saw in the Knysna District, but have received 2; in Natal I saw and took 2 only, but have received 4 from there. *Cenea*, on the contrary, under one or other of its two forms was pretty frequent, but not nearly so much so as the male—owing to less active habits, no doubt."

"December 28, 1903.

"As regards the proportionate numbers of the forms of ♀ *P. cenea*, in say 100 specimens. I can only make a ROUGH GUESS as follows :—

Cenea (true)	50
„ (white-spotted)	40
Grades between *cenea* (white-spotted) and *hippo-coonoides*	4
Hippocoonoides	2
Grades between *hippocoonoides* and *trophonius* . .	3
Trophonius	1
	100

"In this matter the preponderance of *cenea* proper in its two forms is to be expected, because its model *Am. echeria* in two forms is practically the only *Amauris* found in *South* Africa—neither *A. dominicanus* nor *A. ochlea* being at all prevalent even on the Natal coast, and not extending further South. But the rarity of *trophonius* is not easy to account for, if *D. chrysippus* is its model; the latter being numerous and generally distributed. It seems possible that *trophonius* was originally modified in mimicry of *Aletis helcita* in *West* Africa (the Abyssinian extremely rare *ruspinæ* ♀ of *Pap. antinorii* lends support to this view); but, curiously enough, *trophonius* appears to be decidedly rare on the W. Coast as well as in other parts of Equatorial Africa, where *Aletis* is abundant. A single very fine *trophonius* was in Hobley's E. African collection; it was of the *West* African character, but in several marked features much more like *D. chrysippus* than like *Aletis helcita*."

"March 19, 1904.

"It is most difficult to believe that such close mimickers as the second and third females of *antinorii*, the *planemoïdes* female of *merope*, or even (in a less degree) the *trophonius* female of *cenea*, can be as rare as they seem to be. Such admirable mimickers *ought* to be no rarer than the *hippocoon* female of *merope*, or the *cenea* female of *cenea*. It must be remembered that all the females of the group in continental Africa *seem* to be much rarer than the males, yet in the few cases of breeding *P. cenea*—on a very limited scale—there seems to have been no marked disparity in the number of the sexes." *

Mr. Trimen has kindly contributed an Appendix (see p. 691), setting forth the characters and arrangement of this interesting and puzzling group of Papilios. E. B. P.

* See p. 678.

IV. *The Synepigonic Group bred in* 1904 *from a captured female of* HYPOLIMNAS MISIPPUS *intermediate between the type form and the var.* INARIA.

The parent (Plate XXXII, Fig. 1), captured near Durban on January 2, 1904, possesses the white sub-apical bar of

No.	Date of Pupation.	Date of Emergence.	Variety.
1	—— 1904	Feb. 2, 1904	♀ *misippus* (Plate XXXII, Fig. 2).
2	—— ,,	Feb. 2, ,,	♂ smallest male (Fig. 8).
3	Jan. 28, ,,	Feb. 3, ,,	♂ largest male (Fig. 7).
4	Jan. 27, ,,	Feb. 3, ,,	♀ *misippus*, sub-apical white bar of fore-wing similar to that of No. 1.
5	—— ,,	Feb. 4, ,,	♂
6	Jan. 28, ,,	Feb. 4, ,,	♀ *misippus*, sub-apical white bar of fore-wing similar to that of No. 14.
7	—— ,,	Feb. 4, ,,	♂
8	—— ,,	Feb. 4, ,,	♀ like parent, but white bar obscured by brown scales (Fig. 3).
9	—— ,,	Feb. 4, ,,	♀ *inaria*, with bar unusually distinct but brown (Fig. 5).
10	—— ,,	Feb. 5, ,,	♀ *inaria*, similar to No. 12.
11	—— ,,	Feb. 5, ,,	♂
12	Jan. 30, ,,	Feb. 5, ,,	♀ *inaria* (Fig. 6).
13	—— ,,	Feb. 5, ,,	♂
14	Feb. 2, ,,	Feb. 8, ,,	♀ *misippus* (Fig. 4).
15	—— ,,	Feb. 8, ,,	♂
16	—— ,,	Feb. 11, ,,	♂

misippus, although the partial replacement of the black ground-colour of the apex of the fore-wing approaches the

condition found in *inaria*. It is a well-known but not very common variety, of which there are several examples in the Hope Department. Forty-one eggs were laid by this female, and the larvæ hatched on January 9 and 10. They proved to be difficult to rear during the smaller stages, when the larvæ were often buried in the moist fæces produced by the extremely succulent food-plant. The surviving larvæ were however quite healthy, and the imagines with few exceptions of the normal size. The results of the experiment are shown on preceding page in a tabular form.

Comparison of the Individuals of the 1904 *Synepigonic Group of* HYPOLIMNAS MISIPPUS. By E. B. POULTON.

Only a single female out of eight resembled the parent, and even this was a less-pronounced variety. Of the rest, four were typical *misippus*, three typical *inaria*—one of the latter indicating some slight approach in the direction of the parent.

Thus a tendency is revealed which if general must lead to a gradual reduction in the numbers of the intermediate varieties, and an increasingly abrupt break between the *misippus* and *inaria* forms of female. In this instance the intermediate variety had little power to impress its own form on the next generation; for seven out of eight of its female offspring broke up into the two well-known and sharply-separated forms. Although the transition between *misippus* and *inaria* is far more complete than between its models *chrysippus* and *dorippus* (=*klugii*), in correspondence with the fact that a combination of mimetic forms *must* be younger than their models (Trans. Ent. Soc. Lond., 1902, pp. 482–4), the mimic has nevertheless made a considerable advance towards the abruptly-dimorphic condition of the Danaine butterfly which it resembles.

It is unnecessary to describe the male offspring which were entirely normal in appearance, and as a rule in size. The largest and smallest specimens are represented on Plate XXXII, Figs. 7 and 8. E. B. P.

Appendix by Roland Trimen, F.R.S.

The *Merope*-group of the Genus *Papilio*.

A

♂ and ♀ alike in colouring and marking, and both with the hind-wings tailed.

1. *Papilio humbloti*, Oberth.

Both sexes with a well-developed black costal border in the fore-wings terminally truncate at about ⅔ of length of discoidal cell; but in ♀ this border is more or less broadened, and diffusedly expanded to its termination.

[This species is further distinguished from all others in the group by both sexes having on the upper-side the black band of the hind-wings *hind-marginal*, like the black border of the fore-wings.]

Hab. Comoro Islands.

2. *Papilio meriones*, Feld.

♂ with a variable but always much thinner (and brownish-tinged) costal edging in the fore-wings than is shown by *P. humbloti*; ♀ also variable in this character—which is, however, always as well developed as in ♀ *P. humbloti*, and sometimes considerably broader.

Hab. Madagascar.

B

♂ and one form of ♀ as in Section A; but also two other forms of ♀ totally unlike ♂, and (except in retaining the tails of the hind-wings) closely mimetic respectively of *Amauris* and of *Danais* (and *Aletis*).

3. *Papilio antinorii*, Oberth.

I have not seen any figure or proper description of the ♂, but from Oberthür's brief mention in his account of Antinori's collection, I gather that this sex has less black about it than any other ♂ of the group.

From the figures of the ordinary ♀ respectively given by Oberthür and Haase, there must be even more variation in the size of the costal black border in the fore-wings than is shown either by *P. humbloti* ♀ or by *P. meriones* ♀,—Oberthür's figure making this feature very narrow indeed, while Haase's figure represents it as forming terminally a very broad oblique bar extending very nearly to the origins of the 2nd and 3rd branches of the median nervure.

♀, 2nd form, *niavioides*, Kheil.
♀, 3rd form, *ruspinæ*, Kheil.
} Only one example recorded of each of these forms!

Hab. Abyssinia.

C

♂ retaining same form, colouring, and pattern as in Sections A and B; but polymorphic ♀ presenting four forms (with various intermediate grades), all unlike ♂, all without tails on the hind-wings, and (with the apparent exceptions of the form *dionysos* and another which are least divergent from the ♂) closely mimetic respectively of *Amauris*, *Danais* (?also *Aletis*), and *Planema*.

4. *Papilio merope*, Cram.

♀, 1st form (nearest known to ♂, but rare), *dionysos*, Doubl.
♀, 2nd form (prevalent generally), *hippocoon*, Fab.
♀, 3rd form (rare), *trophonius*, Westw., variation.
♀, 4th form (very rare), *planemoïdes*, Trim.

Hab. Western, Central and Eastern Tropical Africa.

5. *Papilio cenea*, Stoll.

♀, 1st form (nearest known to ♂), unnamed.
[Only example known to me is from "Zanzibar," in the Hope Collection.]
♀, 2nd form (not common), *hippocoonoides*, Haase (= *tibullus*, ♀, Kirby).
♀, 3rd form (rare), *trophonius*, Westw.
♀, 4th form (prevalent), *cenea*, Stoll.

Hab. Eastern South-Tropical and Southern Extra-Tropical Africa.

R. TRIMEN.

17/iii/1904.

Note.—I have not followed Aurivillius (*Rhop. Æthiop.*, 1899, p. 464) in associating with this group *Pap. nobilis*, Rogenh. On examination of specimens of both sexes of this species—kindly lent to me by Dr. Jordan of the Tring Museum—it is perfectly clear that, notwithstanding the general superficial resemblance borne by *P. nobilis* to the more primitive forms of the *Merope*-group, it differs too widely from the latter, alike in structure, colouring, and system of markings, to be placed with them. The butterfly exhibits, however, so many features in common with those of the *Hesperus*-group, that, if not included in this group, it should constitute a separate one in the immediate proximity.

Explanation of Plate XXXI.

All the figures are represented slightly more than half the natural size.

Two Synepigonic Groups of *Papilio cenea* together with their parents—a *cenea* form and a *trophonius* form respectively.

Fig. 1. The female parent of the 1902 group, captured *in copulâ* with the male represented in Fig. 2. The butterfly represented in Fig. 1 is a typical white-spotted Natal *cenea* form. A selection of the female offspring is shown in Figs. 3–8.

2. The male parent. The prominent black band of the hind-wing is rather less heavily marked than is usual in Southern forms. This feature was inherited by the male offspring.

3. Female offspring of the *cenea* form described as III. in this memoir. A white-spotted Natal form showing some transition towards the buff-spotted variety.

4. Female offspring of the *cenea* form, described as V. Rather more transitional towards the buff-spotted form than III.

5. Dwarfed female offspring of the *cenea* form, described as IV. Intermediate between the females represented in Figs. 3 and 4.

6. Much-dwarfed female offspring of the *cenea* form, described as VI. The specimen represented is nearest to the typical buff-spotted Southern form of female *cenea*.

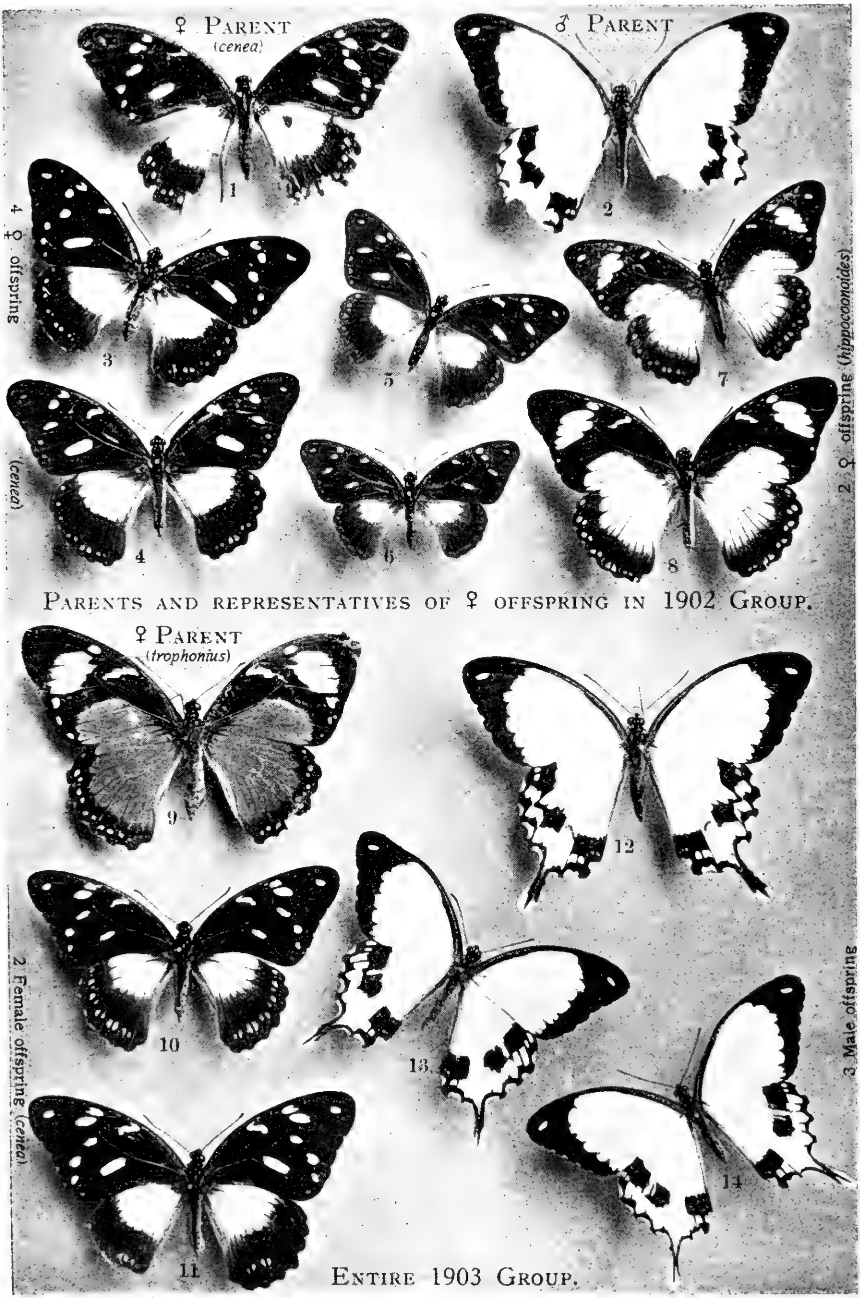
7 & 8. Two female offspring of the *hippocoonoides* form. Both typical except for their stunted size, especially marked in Fig. 7.

9. The female parent of the 1903 Synepigonic group captured near Durban on Sept. 18, 1903. It is seen to be a typical *trophonius* form. From this female seven eggs were obtained, yielding the five imagines represented in Figs. 10–14.

10. Female offspring of the *cenea* form: a white-spotted variety similar to the female described as II. in the 1902 family. The chief spot (1) of the fore-wing is unusually small.

11. Female offspring of the *cenea* form: a typical white-spotted variety similar to I. of the 1902 family.

12–14. The male offspring.



Alfred Robinson, phot. André & Sleigh, Ltd.

All the figures are slightly more than half the natural size.

Forms of *Papilio cenea* bred in 1902 from a *cenea* form of female, and in 1903 from a *trophonius* form of female.

Durban, Natal.

Explanation of Plate XXXII.

All the figures are represented nearly $\frac{4}{5}$ of the natural size.

A variety of *Hypolimnas misippus* ♀, together with types of the offspring reared from its eggs.

Fig. 1. The parent. Captured Jan. 2, 1904, at Durban, Natal. Laid 41 eggs, from which 16 butterflies were reared. Examples of all varieties among the offspring are represented in the remaining figures of this plate.

2. Female. Form *misippus*. Emerged from the pupa Feb. 2, 1904. Another female with the sub-apical white bar of a very similar shape emerged Feb. 3, 1904 (pupated Jan. 27).

3. Female. Form intermediate between *misippus* and *inaria*, resembling parent except that the white sub-apical bar is much obscured by scattered brown scales, the difference being greater than is indicated by a comparison of figures 3 and 1. This is the only one of the offspring which resembles the parent at all closely. Emerged Feb. 4, 1904.

4. Female. Form *misippus* Emerged Feb. 8, 1904 (pupated Feb. 2). Another female with the sub-apical white bar of a very similar shape emerged Feb. 4, 1904 (pupated Jan. 28).

5. Female. Form *inaria*. A slight approach towards the parental form is seen in the sharp and distinct outline of the sub-apical bar, which however possesses the normal brown shade of *inaria*. Emerged Feb. 4, 1904.

6. Female. Form *inaria*. Emerged Feb. 5, 1904 (pupated Jan. 30). Another similar female emerged Feb. 5, 1904.

7. Male. Emerged Feb. 3, 1904 (pupated Jan. 28). The largest of the eight male offspring.

8. Male. Emerged Feb. 2, 1904. The smallest of the eight male offspring. The six unfigured males emerged on Feb. 4 (two ; one small), Feb. 5 (two ; one of them rather small), Feb. 8, and Feb. 11.

Alfred Robinson, phot.

André & Sleigh, Ltd.

All the figures are nearly $\frac{1}{5}$ of the natural size.

Hypolimnas misippus, ♀, var., together with representatives of the offspring reared from its eggs.

Durban, Natal, 1904.

XV. Pseudacræa poggei *and* Limnas chrysippus; *the numerical proportion of mimic to model.* By HORACE A. BYATT, B.A., F.E.S. *With a note* by Professor E. B. POULTON, D.Sc., M.A., F.R.S., etc.

[Read April 5th, 1905.]

PLATE XIV.

THESE butterflies were found among a collection of some 1200 specimens given to me by Père Guillemé of the White Fathers' Mission to Central Africa, under whose direction they were collected at his station at Kayambi, in Awemba country, N.E. Rhodesia, near the sources of the Congo, locally called the Chambezi, between October 1898 and January 1899.

His system was to send out a number of native schoolboys—his "gamins," as he called them—each armed with a net and a book, and orders to capture anything and everything that came in their way, placing their captures between the leaves of the book for safe carrying home.

He particularly mentions that he told his boys to take "des spécimens aussi variés que possible;" and that they would do this literally I know from my own experience of natives, for I have found them generally unable to discriminate between species, and when sent out by me on similar occasions they have returned with large numbers of the insect most in evidence at the moment, and a proportionally smaller number of others. It is, therefore, allowable to suppose that the whole lot which came into my possession gives a very fair idea indeed of the numerical strength of the several species found in the locality.

On opening the papers and examining the specimens—which have suffered a good deal from the damp and neglect of seven years—it was found that roughly one-third of the whole collection consisted of *Limnas chrysippus*, L., and its mimics; and among these latter were seventeen specimens of *Pseudacræa poggei*, Dewitz,—many of them in a fair state of preservation, though, with the rest, they show signs of being unduly pressed between the pages of the book, and are somewhat dulled in colour by damp.

It is due to the suggestion of Professor Poulton that this would be an excellent opportunity to ascertain what numerical relation the *Pseudacræa* bears to its model *chrysippus* that this paper has been hastily prepared in the Hope Department at Oxford before my return to Central Africa.

The country in which Kayambi is situated does not differ greatly from the rest of the plateau to the W. of Lake Nyassa and N.E. Rhodesia. Large stretches of undulating plains, covered with thin scrubby bush or dense tall grass, are intersected at intervals of 5–20 miles by streams and rivers. In the latter months of the year, when these insects were mostly collected, these plains are bare, dry, and dusty, grass and bush being burnt up by the annual bush-fires: and only along the streams is any verdure found. Père Guillemé describes the soil as fertile along the course of the rivers, but elsewhere the district is generally poor and sandy, and for this reason sparsely inhabited, and he remarks on bush-fires being the cause of the general scarcity of insect-life except along the water-courses, where the vegetation is untouched by fires, and where forest-giants, trailing creepers, and tree-ferns flourish.

The altitude of Kayambi is about 3950 ft. above sea-level; and its position roughly 9° 20′ S. and 31° 50′ E., some two days' march from Fife, and three from Abercorn, on the Nyassa-Tanganyika plateau.

The respective numbers and species in the collection were worked out in the Hope Department and are stated in tabular form below:—

SPECIES.	♂	♀	TOTAL.
Limnas chrysippus . .	288	79	367
do. do. var. *dorippus*	8	4	12
Pseudacræa poggei . .	—	—	17
Hypolimnas misippus . .	36	7	45
,, ,, ♀ var. *inaria*		2	

Total number in group 441

From this table it will be seen that *Pseudacræa poggei* is by no means so rare as has been hitherto supposed; its proportion to *L. chrysippus* is no less than 4·72 per cent. The *dorippus*, Kl., or *klugii*, Butl., form of *chrysippus*

is found, but in this whole series of seventeen specimens of *poggei* no individual shows any resemblance to *dorippus*: it is purely a mimic of *chrysippus* and shows no approach to dimorphism. This is explainable on the ground that it is found only where *chrysippus* is the largely predominant form, and, so far as is known, it does not occur in, or has not yet reached, the parts where *dorippus* is relatively abundant—that is, the desert strip along the E. Coast, extending in the E. African Protectorate inland at least to the shores of Victoria Nyanza. In this respect it compares in an interesting manner with *misippus* ♀, of which the *inaria* form, mimicking *dorippus*, is found all over Africa (Trans. Ent. Soc. Lond., 1902, pp. 473–484): and also with *Acræa encedon*, L., var. *daira*, G. and S., which is only frequent in localities where its type *dorippus* is predominant (l. c. pp. 473–484).

This occurrence in considerable numbers of what has hitherto been regarded as the rarest species of *Pseudacræa* supports the hypothesis that the mimics of this group are Müllerian rather than Batesian. This has already been argued for *H. misippus* (cf. Rep. Amer. Assoc. Adv. Sci.—Detroit, 1897; and Trans. Ent. Soc. Lond., 1902, pp. 480 and 483, with references) as well as for the genus *Pseudacræa* and for *A. encedon* (pp. 480, etc.). The fact that the latter species, belonging to a protected and much-mimicked subfamily, is far more coincident geographically with the corresponding forms of its model *H. misippus* ♀ is obviously a powerful argument in favour of the Müllerian interpretation.

Note by Professor E. B. Poulton, F.R.S.

It is deeply interesting to compare the details of the mimetic resemblance borne by *Pseudacræa poggei* to *Limnas chrysippus* with those of the other great Nymphaline mimic—*Hypolimnas misippus* ♀. Almost all the points in the following statement can be verified by means of the half-tone reproductions of the three species on the accompanying Plate XIV. It is to be observed, however, that Fig. 1 represents a ♀ *chrysippus* with five wings, a second smaller left hind-wing concealing the central portion of the normal hind-wing of the same side.

As this rare monstrosity was found among the large number of specimens tabulated by Mr. H. A. Byatt it was thought well to select it for representation, inasmuch as the teratological interest is simply an additional advantage which in no way interferes with the bionomic interest of the plate.

The subapical white bar on the fore-wing of *chrysippus* is prolonged downwards and outwards with a slight inward trend by means of a few small marginal spots and a local intensification of the white elements in the fringe. This character is very persistent, and is traceable in the *dorippus* form when the band itself has, except for its costal end, disappeared (compare Fig. 4 with 1). A similar effect is produced in the ♀ *misippus* (Fig. 2) by the position of the last or fifth spot of the band, by a local strengthening of the two rows of whitish hind-marginal lunules, and by the white elements of the fringe. The three narrow interrupted white lines which are thus formed parallel with the hind-margin, persist in the *inaria* form when the band itself is only faintly traceable (compare Fig. 5 with 2). In both *chrysippus* and *misippus* it is obvious, especially in the latter, that this prominent subapical marking is in large part prolonged by the local strengthening or the local persistence of elements which are not part of the bar itself, but belong to the category of marginal markings. In this respect *Pseudacræa poggei* (Fig. 3) stands in considerable contrast with the other two members of the group; for its bar is prolonged—and much more fully prolonged than in the other species—by elements which have the appearance of continuity with the bar itself. If these elements are marginal markings as in *chrysippus* and *misippus* they have been far more subordinated to the subapical bar than in these species. The local strengthening of white elements in the fringe is also somewhat less marked, and plays a less important part in *poggei* than in the others. As regards the few minute spots at the extreme apex of the fore-wing of *chrysippus*, mimetic resemblance is more honoured in the breach by *poggei* than in the too emphasized observance by *misippus* ♀—to say nothing of the very different position of the marking in model and mimic.

In spite of all these differences in detail, the two mimics are by no means unlike; and in general effect

each of them resembles the other more closely than it resembles the model.

The internal contour of the black hind-marginal border of both wings is prolonged inwards along the veins, producing a festooned appearance in *poggei* (Fig. 3) and, to a far smaller degree, in the model (Fig. 1). In the ♀ *misippus* (Fig. 2) this feature is almost wanting. Apart from the contour, the narrow black border of the hind-wings of *poggei* more closely resembles the model than the broader more interrupted and less sharply outlined border of the ♀ *misippus.* At the same time, the two mimics resemble each other in this character more fully than either of them resembles the model, which is widely separated by the row of distinct white spots, which however are very variable, and not infrequently barely traceable. On the under-side of both wings the border of *misippus* (Fig. 2*a*) reproduces the black and white effect of the model (Fig. 1*a*), far better than *poggei* (Fig. 3*a*), in which the white marginal elements are confined to the fringe. On the other hand, in the lighter tint of the veins of the hind-wing under-side and in the colour and texture of the ground-colour, *poggei* is by far the better mimic of the two, while *misippus* is equally superior in the tint of the apical area of the fore-wing under-side beyond the bar. As regards the black discal spots of the hind-wing under-side *poggei* is the closer mimic. The development and shifting outwards of the peripheral spots is an evident special modification, in the direction of the model, of a characteristic feature of the genus *Pseudacræa.* The two small spots nearest to the centre of the wing (see Fig. 3*a*) were only seen in a single specimen out of the seventeen. They indicate the existence of material which may be developed into a still closer likeness to the Danaine model.—E. B. P.

Explanation of Plate XIV.

All the figures are two-thirds of the natural size.

Limnas chrysippus with its two chief mimics, from the sources of the Congo.

Fig. 1. *Limnas chrysippus*, ♀, upper-side. The specimen possesses a second smaller hind-wing on the left side.

1*a*. *Limnas chrysippus*, ♂, under-side.

2. *Hypolimnas misippus*, ♀, upper-side.

2*a*. „ „ ♀, under-side.

3. *Pseudacræa poggei*, upper-side.

3*a*. „ „ under-side.

4. *Limnas chrysippus*, form *dorippus* (*Klugii*), ♂, upper-side.

5. *Hypolimnas misippus*, ♀ form *inaria*, upper-side.

Alfred Robinson, photo.

Andre & Sleigh, Ltd.

All the figures are ⅔ of the natural size.

Limnas chrysippus with its two chief mimics, from the sources of the Congo.

XXII. Hymenoptera Aculeata *from Majorca* (1901) *and Spain* (1901–2). By EDWARD SAUNDERS, F.R.S. *With Introduction, Notes, and Appendix* by Prof. EDWARD B. POULTON, F.R.S.

[Read June 1st, 1904.]

I. MAJORCA (1901).

THE Majorcan Aculeates named and described by Mr. Saunders in this memoir were collected by Mr. W. Holland, of the Hope Department, Oxford, Mr. A. H. Hamm, of the same Department, and myself. The entire collection was made from June 26 to July 12, 1901, in the neighbourhood of Palma, Soller and Pollensa, or in travelling between these places.

On returning home with many thousands of specimens belonging to nearly all groups, including those obtained in a week's hard work on the mainland, the expenditure of an immense amount of careful mechanical labour was necessary before the work of determination could begin. Interrupted by calls which could not be postponed, about eighteen months elapsed before I was in a position to submit the Aculeates to my kind friend, Mr. Edward Saunders, F.R.S., who has rendered such memorable help to the Hope Department on many occasions.

The Majorcan Aculeates numbered rather over 3680, and of these about 2500 were in the first instance examined by Mr. Saunders. The remaining specimens, which had been looked upon as duplicates of the commonest species, were subsequently studied by him, and a few species of interest recovered from among them.

It will be seen in his memoir that Mr. Saunders recognises five new species in this material:—*Pompilus poultoni*, *Mimesa pallidítarsis*, *Halictus dubitabilis*, *H. hollandi*, and *H. hammi*.

It is unnecessary again to describe the features of this beautiful island with its triple division into (1) level highly-cultivated plains, (2) mountains chiefly developed along the N.-W. coast, and (3) low marshy land on the N.-E. bordering parts of the bays of Alcudia and Pollensa.

After my first visit to Majorca in 1900 I gave some account of the main characteristics which appeal to the naturalist (Ent. Monthly Magazine, Sept. 1901, p. 205). All three types of country were included in the route taken in 1902, of which a brief account is given below.

June 26.—We landed at Palma in the morning after an all-night passage from Barcelona. In the afternoon we took the Porti Pi tram in order to visit the hill, on the summit of which Bellver Castle stands at a height of 400 ft. "This was the most favourable locality . . . met with during the visit in 1900" (l. c., p. 206), and here I caught the fine new species of *Nomada* described by Mr. Edward Saunders (l. c., pp. 209, 210). In July the conditions had greatly changed. The flowers were over and withered on the exposed surface, and the locality was not especially productive.

After collecting for a time, we descended the heath-covered southern slope and made our way to the coast, a little beyond Porto Pi, working the top and occasionally the face of the low cliffs beside the coast road running out of Palma in a S.-W. direction. Along this little strip of coast there was every degree of slope, while a considerable number of flowers were still to be found. Although it was late in the afternoon insects were fairly abundant and varied.

June 27.—The experience of the previous day induced us to make further trial of the coast beyond the tram terminus at Porto Pi. We explored the varied types of collecting ground to be found along the cliffs as far as the 6th kilometre on the coast road. At Porto Pi itself, and again at the furthest point, a little bay was found, with favourable ground running down to sea-level. At the 6th kilometre we explored part of a valley which ran inland from the bay. A fine rounded, heath-clad hill rising behind the cliffs was also traversed.

June 28.—Mr. Holland was ill and unable to walk. Mr. Hamm and I collected for 13 kilometres along the straight, level highway running S.-E. of Palma to Lluchmayor. We never wandered far from this glaring, dusty road, occupying most of the time upon the wayside flowers, where insects were abundant. Irrigation tanks, fields of lucerne, and on one occasion an old garden were also visited. The whole day's work lay in the fertile and highly-cultivated plain.

June 29.—During my visit in the previous year I had made a special note of the Pass of Soller, 22 kilometres from Palma, as likely to be a favourable locality. The varied character of the ground, the numerous plants, the high elevation above the Plain of Palma behind, and the Valley of Soller in front, the descent on both sides, the much higher ground readily accessible on either hand, all pointed to the Pass as a place in which a naturalist might well spend a few days.

We started to drive across the Plain of Palma towards the foot of the Pass, without any certainty that we should find a place to sleep in. When well out in the middle of the Plain we stopped at a neglected field covered with umbelliferous flowers and collected for an hour. I had specially bargained at the Fonda Mallorca for a most persuasive driver, who would do his best to induce the proprietress of the little inn on the summit to allow us to stay. He certainly acted up to his promise, and undeterred by repeated failure, plied every oratorical art for a considerable part of the afternoon. Although several times the hostess seemed to be upon the point of yielding she was finally inexorable. At last, however, she suggested that we should ask if we might stay at a neighbouring house—Son Allegra—where Señor Antonio Pascual resided. Here we were kindly received, and here our collection attracted the most lively interest and inquiry. In dumb show—for the Señor understood no English, and I only a word or two of Mallorquin—I was asked whether our captures were not intended to be stirred up in water and drunk as a medicine! The idea that insects were taken in order to be eaten or used as medicine was also met with many times in various parts of the island.

Towards the close of that afternoon we collected upon the summit of the Pass and the eastern slope rising from it.

June 30.—The whole of this day was occupied in working the summit and the slopes rising and descending from it.

July 1.—The steep southern slope leading from the summit to the Plain of Palma was explored from top to bottom, and a little work was done on the edge of the Plain.

July 2.—This day was passed like June 30, at and near the summit. I explored the high ground rising to the

west and found it favourable. Beyond the gardens of the few houses on this side of the Pass rose wooded slopes thinly covered with trees of medium size; beyond these cornfields were found bordered in certain parts by abundant flowers. Higher still was the bare mountain side; although even here the frugal islanders do not leave Nature to herself, for they turn out those most destructive of domestic mammals, goats and pigs.

July 3.—These western slopes rising high above the Pass seemed so favourable that we all spent July 3 in again exploring them.

July 4.—We left the Pass with regret. The view to the south of the vast Plain of Palma was a striking and beautiful contrast with that to the north,—the Valley of Soller shut in by steep hillsides, with the magnificent outline of the Piug Mayor, the highest mountain in the island, rising behind Soller itself in the centre of the picture.

The locality would probably be far more productive a little earlier in the year. Should any entomologist think of collecting there it will not be out of place to inform him that the only food consists of eggs, bread, fruit, coffee, and goats' milk. The fowls are not to be recommended.

We walked down the northern slope into Soller in the morning, collecting by the roadside. In the afternoon we worked between Soller and its Port, $2\frac{1}{2}$ miles distant, taking the majority of our captures from the flowers on the sides of the dry river-bed near the little town.

July 5.—All the baggage which could be dispensed with had been left in Palma, together with the captures made before June 29. The collections accumulated since the start for Soller Pass were loaded, with our very moderate supply of luggage, on the back of one mule, for the journey by mountain roads to Lluch and then Pollensa. As I watched the mass of boxes and bundles swaying from side to side and up and down, I was filled with needless fear for the safety of the specimens. The motion, with all its amplitude and rapidity, is so absolutely smooth and springy, and so devoid of sudden jerks, that not a single insect was displaced or in the slightest degree injured by the two days' journey.

Our course lay up the steep Barranco, above which some very fine upland collecting ground was traversed. In one flowery valley *Argynnis pandora* was seen in some numbers. It was only met with singly in other

localities in the island. At one point where a mountain stream formed a deep pool in a narrow rocky gorge, a species of *Notonecta* abounded in the water. Many an interesting and favourable locality made us regret that it was necessary to reach Lluch that night. We were kindly received, according to the hospitable traditions of the old-world monastic building, at the Colegio de Lluch.

July 6.—Before starting by the bridle-path for Pollensa we worked for about an hour in the broad valley near the building, and judging from this limited experience the locality appeared to provide better all-round collecting than any other place visited by us in the island.

When within a few miles of the ancient town a good deal of work was done in some flowery fields beside a stream. We arrived in time to visit Monte Sentuiri—a steep isolated hill which I had explored in 1900.

July 7.—This day was occupied in a walk to and from the Castillo del Rey. Many opportunities for good collecting were found in favourable spots by the path through the woods and here and there in the broad open valley beyond. Some of the mountain slopes near the ruined castle were clothed in a long coarse grass, all the more noticeable because of its scarcity in other places. Hopes, not destined to be fulfilled, were raised of the capture of Erebias.

July 8.—The day was occupied in a visit to the Port of Pollensa and in collecting on the low marshy ground, the Little Albufera, which borders the bay. Odonata were abundant by the irrigation ditches, and the flowers yielded a good harvest of insects. Much work was done in favourable spots by the side of the hot white road between Pollensa and its Port.

July 9.—The results of the 8th were so favourable, and the locality so different from any other we had visited, that it was determined to spend the last day at Pollensa at the Little Albufera. Much road-side collecting was done as on the 8th.

July 10.—We took the diligence to La Puebla and the train thence to Palma, arriving in time to spend the afternoon at Bellver Castle and the cliffs beyond Porto Pi as far as the 6th kilometre on the coast road, going over the ground explored on June 27.

July 11.—Up to this date there had been nothing but bright hot sun and cloudless skies. The change came on

the morning of the 11th, with a terrific downpour, which made us think that the weather had broken. In the afternoon, however, the sun shone as brightly as before, and we hastened to look for the insects which had been driven into cover by the dry heat of the previous days. We followed the route of the previous day, and Mr. Holland collected a fine assortment of species of *Blaps* under stones near Bellver Castle.

July 12.—On this, our last day in the island, we collected from the tram terminus at Porto Pi to the 6th kilometre on the coast road, returning in time to pack up and catch the boat which makes the night journey to Barcelona.

Reviewing the whole visit, it must be admitted that the weather was almost perfect, although a little more rain would probably have been advantageous. On the other hand, there can be no doubt that insects are far more abundant in species earlier in the summer. My visit to Majorca in the cold, cloudy and wet spring of 1900 was too early for the best results, ending as it did on April 4. Our visit in 1901 was too late. The withered remains of flowers in every direction gave some indication of favourable conditions which had passed away for the year, and although we searched for and found many of the late-blooming plants, it was obvious that these were very few as compared with the species whose flowering time was over. In spite of the poor weather the flowers were abundant and varied in March 1900, and included showy species which cover large areas, such as asphodel and various kinds of cistus. In the 1901 visit the flowers were generally of far less conspicuous kinds, and required to be sought for. I believe that May and the second half of April would be the best possible time for the entomologist in the Balearic Islands.

Sweeping was generally of little use, because of the hard prickly nature of the plants. Beating trees and shrubs in the evening was tolerably productive of the smaller moths.

In conclusion, it is a great pleasure to speak of the uniform kindness and hospitality of the people, and of their intense interest in the mysteries of the naturalist. Almost the whole population of the Port of Pollensa assembled to see us eat our simple lunch and look at the contents of the cyanide bottles; while at Pollensa an inquiry as to the Mallorquin names of insects produced a scene of wild excitement and dispute. Many an interesting and amus-

ing incident is recalled, and many a pleasant memory revived, by this attempt to write a brief account of our visit to Majorca.

EDWARD B. POULTON.

Oxford, July 9, 1904.

All the insects having been captured in 1901, *it has not been considered necessary to make further reference to the year. The captors are indicated by their initials, E. B. P., W. H., and A. H.*

CAMPONOTUS SICHELI, Mayr.

Little Albufera: *July* 9.—1 ☿ W. H.

CAMPONOTUS LATERALIS, Oliv., var.

Near Porto Pi: *July* 10.—1 ☿ W. H.

LASIUS NIGER, L.

Near Palma, Lluchmayor Road: *June* 28.—♂ and ♀ *in copulâ* A. H.
Soller Pass, below S. zigzags: *July* 1.—8 ♀ W. H.
Soller Pass, upper half of S. zigzags: *July* 1.—13 ☿ A. H.
Soller to Port: *July* 4.—1 ♀ winged A. H.
Little Albufera: *July* 8.—3 ☿. *July* 9.—19 ☿ W. H.
Road from Pollensa to Port: *July* 9.—2 ☿ W. H.

ACANTHOLEPIS FRAUENFELDII, Mayr.

Castle Bellver, 250–400 ft.: *June* 26.—1 ☿ A. H.
Near Porto Pi: *June* 27.—4 ☿ A. H. *July* 12.—1 ☿ E. B. P., 1 ☿ A. H.

MONOMORIUM SALOMONIS, L.

Near Porto Pi: *July* 12.—6 ☿ A. H.
Soller Pass, below S. zigzags: *July* 1.—1 ☿ A. H.
Upper half of S. zigzags: *July* 1.—1 ☿ A. H.
Soller to Port: *July* 4.—1 ☿ E. B. P.

APHÆNOGASTER STRUCTOR, Latr. ☿.

Castle Bellver, 250–400 ft.: *June* 26.—1 ☿ W. H.
Near Porto Pi: *June* 27.—10 ☿ E. B. P., 13 ☿ W. H., 12 ☿ A. H.
Near Palma, Lluchmayor Road: *June* 28.—5 ☿ A. H.

Plain of Palma, road to Soller: *June* 29.—4 ☿ W. H.
Soller Pass: *June* 29.—1 ☿ W. H. *June* 30.—1 ☿ W. H.

Aphænogaster barbara, L.

Castle Bellver, 250–400 ft.: *June* 26.—1 ☿ W. H.
Little Albufera: *July* 8.—21 ☿ W. H.

Aphænogaster testaceopilosa, Luc.

Near Porto Pi: *July* 12.—6 ☿ A. H.

Pheidole megacephala, F.

Soller Pass: *June* 29.—1 ♀ E. B. P.
Base of Monte Sentuiri: *July* 6.—3 ♀ W. H.
Pollensa: *July* 6.—2 ♂, 2 ♀, 90 ☿ A. H.
Little Albufera: *July* 9.—1 ♀ W. H.

Cremastogaster sordidula, Nyl.

Little Albufera: *July* 9.—2 ☿ W. H.

Cremastogaster scutellaris, Oliv.

Near Porto Pi: *July* 11.—2 pairs *in copulâ,* 6 winged 2 wingless ♀ E. B. P.; 5 pairs *in copulâ,* 7 winged ♀ W. H.; 2 pairs *in copulâ,* 1 ♂, 15 ♀ (1 wingless), A. H.
Soller Pass, below S. zigzags: *July* 1.—1 ☿ A. H.
Soller Pass, upper half of zigzags: *July* 1.—1 ☿ A. H.
Soller Pass: *July* 2.—23 ☿ A. H.

Cremastogaster scutellaris, race læstrygon, Emery.

Castle Bellver, 250–400 ft.: *June* 26.—8 ☿ W. H., 5 ☿ A. H. *July* 11.—1 ☿ E. B. P., 1 ☿ A. H.
Near Porto Pi: *June* 27.—1 ☿ E. B. P., 1 ☿ W. H., 15 ☿ A. H. *July* 10.—6 ☿ E. B. P., 1 ☿ W. H. *July* 12.—1 ☿ W. H.
Soller Pass, upper half of zigzags: *July* 1.—1 ☿ A. H.

Mutilla partita, Klug.

Castle Bellver, 250–400 ft.: *June* 26.—2 ♂ A. H.
Near Porto Pi: *June* 27.—1 ♂ A. H. *July* 10. —1 ♂ E. B. P., 1 ♂ W. H.

MYRMOSA COGNATA, Cost.

Soller Pass: *June* 30.—1 ♂ E. B. P.

MYZINE TRIPUNCTATA, Rossi.

Little Albufera: *July* 8.—1 ♂ W. H., 6 ♂ A. H. *July* 9.—4 ♂ A. H.

MYZINE TRIPUNCTATA, var. NIGRIFRONS, Sm.

Near Porto Pi: *June* 27.—2 ♂ E. B. P., 1 ♂ A. H. *July* 12.—4 ♂ E. B. P., 3 ♂ W. H., 2 ♂ A. H. Probably a variety of the preceding with the clypeus black.

SCOLIA 4-PUNCTATA, F.

Abundant everywhere.

SCOLIA FLAVIFRONS, F.

Castle Bellver, 250–400 ft.: *June* 26.—1 ♂ E. B. P., 1 ♂ W. H.
Near Porto Pi: *June* 27.—1 ♀ A. H.
Soller to Port: *July* 4.—1 ♂ A. H.
Road from Lluch to Pollensa: *July* 6.—3 ♂ A. H.
Little Albufera: *July* 9.—1 ♀ A. H.

POMPILUS (*Planiceps*) CASTOR, Kohl.

Near Porto Pi: *June* 27.—1 ♀ E. B. P.
Soller to Lluch: *July* 5.—1 ♂ A. H.

POMPILUS (*Pedinaspis*) OPERCULATUS, Klug.

Near Porto Pi: *June* 27.—3 ♀ E. B. P., 3 ♀ W. H., 1 ♂, 3 ♀ A. H. *July* 10.—1 ♂, 2 ♀ E. B. P., 4 ♀ W. H., 2 ♀ A. H. *July* 12.—4 ♀ E. B. P., 2 ♀ W. H., 2 ♀ A. H.
Near Palma, Lluchmayor Road: *June* 28.—2 ♀ E. B. P., 1 ♀ A. H.
Plain of Palma, road to Soller: *June* 29.—1 ♀ W. H.
Soller Pass: *June* 30.—2 ♂, 1 ♀ E. B. P. *July* 2.—1 ♀ W. H.
Soller Pass, upper half of S. zigzags: *July* 1.—1 ♂ A. H.
Above Soller Pass: *July* 3.—1 ♀ A. H.
Pollensa to Castillo del Rey: *July* 7.—1 ♀ A. H.

Road from Pollensa to Port: *July* 8.—1 ♂, 2 ♀ E. B. P., 5 ♀ W. H., 3 ♀ A. H. *July* 9.—1 ♀ E. B. P., 1 ♀ W. H., 3 ♀ A. H.
Castle Bellver, 250–400 ft.: *July* 11.—1 ♀ A. H.

POMPILUS VIATICUS, L.

18 ♀, 9 ♂. *June* 28 to *July* 9.

[On July 3, above Soller Pass, a female of this species was found carrying a brown spider of very large size as compared with its captor. E. B. P.]

POMPILUS CHALYBEATUS, Schiödte.

Castle Bellver, 250–400 ft.: *June* 26.—1 ♂ E. B. P.
Little Albufera: *July* 8.—2 ♀ E. B. P., 1 ♂ A. H. *July* 9.—1 ♂, 3 ♀ A. H.
Near Porto Pi: *July* 10.—1 ♂ E. B. P.

POMPILUS UNGUICULARIS, Thoms., var. (?).

Plain of Palma, road to Soller: *June* 29.—1 ♂ A. H.
Near Porto Pi: *July* 12.—1 ♂ W. H.

POMPILUS, sp. (?).

Above Soller Pass: *July* 3.—1 ♂ W. H.

POMPILUS, sp. (?).

Near Porto Pi: *July* 10.—1 ♀ W. H., 1 ♀ A. H. *July* 12.—1 ♀ E. B. P.

POMPILUS EFFODIENS, Fert.

Castle Bellver, 250–400 ft.: *June* 26.—1 ♀ A. H.
Near Porto Pi: *July* 12.—1 ♀ W. H.
Road from Pollensa to Port: *July* 8.—1 ♀ A. H.

POMPILUS RUFIPES, L.

Soller Pass: *June* 30.—1 ♂ E. B. P.
Above Soller Pass: *July* 3.—1 ♂ W. H.

POMPILUS COCCINEIPES, E. Saund.

Plain of Palma, road to Soller: *June* 29.—1 ♀ A. H.

Described from Algerian specimens. I have not seen it from any other localities.

POMPILUS POULTONI, sp. nov.

Niger, capite thoraceque aureopubescentibus, mandibularum apicibus, abdomine toto, femoribus tibiisque posticis rufis; pronoto

postice margine angulatim emarginato, late pallido, metatarsis anticis 4 spinosis, unguiculis simplicibus.

♀. Black, apex of the mandibles, entire abdomen, posterior femora and tibiæ except at their bases and apices red, pronotum angularly emarginate at the base, the margin widely pale, wings with three submarginal cells.

♂ colour paler than in the ♀, abdomen with the apex and underside of the basal segment and a spot on each side of the 2nd, apices of all the femora, the intermediate tibiæ and the anterior and posterior tibiæ on their under-sides testaceous, pronotum as in the ♀.

♀. Clypeus and the lower part of the face, especially at the sides and also behind the eyes, densely clothed with pale golden hairs, a similar pubescence covers the front of the pronotum, the pleuræ, the coxæ, the extreme base of the mesonotum, the sides of the scutellum and post-scutellum, and the whole of the propodeum; vertex with a few erect hairs, pronotum at the base sharply emarginate, its actual margin membranous, the pale band very narrowly and deeply sinuate in the centre, wings dusky with a darker apical band, 3rd submarginal cell triangular, in the wing of one specimen with a slight petiole; propodeum widely channelled down the centre, its surface very finely microscopically reticulate. Comb of anterior metatarsus with 4 short spines, claws simple throughout, 4th and 5th joints of posterior tarsi subequal.

Long. 7·8 m.m.

The ♂ which I have associated with this ♀ is exactly similar in the form of the prothoracic emargination and pale band, but is much worn, so that most of the pubescence has probably been lost; the 3rd submarginal cell of the wings is trapezoidal; the inner posterior calcar is four-fifths as long as the metatarsus; abdomen compressed laterally, but unfortunately in the only specimen captured the terminal segments are "telescoped" up, so that I cannot get a good view of their shapes.

Long. 5–6 m.m.

Soller Pass: *June* 30.—1 ♀ W. H. *July* 3.—1 ♂ A. H. Above Pass.
Soller to Lluch: *July* 5.—1 ♂ W. H.
Castle Bellver, 250–400 ft.: *July* 11.—1 ♂ E. B. P.

Pompilus cingulatus, Rossi.

Near Porti Pi: *June* 27.—2 ♀ E. B. P. *July* 12.—2 ♀ E. B. P., 2 ♀ W. H.

Near Palma, Lluchmayor Road: *June* 28.—1 ♀ A. H.
Soller Pass: *June* 30.—1 ♀ W. H.
Soller Pass, upper half of S. zigzags: *July* 1.—2 ♀ A. H.
Above Soller Pass: *July* 3.—1 ♂ W. H.
Soller to Lluch: *July* 5.—1 ♀ W. H., 2 ♀ A. H.
Road from Pollensa to Port: *July* 9.—1 ♀ E. B. P.

POMPILUS APICALIS, V. de L.

Soller Pass: *June* 29.—1 ♀ W. H.
Soller to Lluch: *July* 5.—1 ♀ A. H.
Base of Monte Sentuiri: *July* 6.—1 ♀ A. H.

POMPILUS NIGER, F.

Little Albufera: *July* 8.—1 ♂, 2 ♀ A. H. *July* 9.—2 ♂ E. B. P.

POMPILUS APPROXIMATUS, Sm.

Soller to Lluch: *July* 5.—1 ♀ A. H.
Little Albufera: *July* 9.—1 ♀ A. H.

POMPILUS HOLOMELAS, Cost.

Soller Pass, upper half of S. zigzags: *July* 1.—2 ♀ A. H.
Above Soller Pass: *July* 3.—1 ♀ E. B. P.

SALIUS BISDECORATUS, Cost.

Near Palma, Lluchmayor Road: *June* 28.—1 ♀ E. B. P.
Road from Pollensa to Port: *July* 8.—2 ♂, 3 ♀ E. B. P., 3 ♂, 2 ♀ W. H., 2 ♂ A. H. *July* 9.—2 ♂, 7 ♀ E. B. P., 2 ♂, 8 ♀ W. H., 1 ♂, 8 ♀ A. H.
Little Albufera: *July* 8.—1 ♂ E. B. P., 1 ♂ A. H. *July* 9.—1 ♂ W. H., 1 ♀ A. H.

[The two pairs of yellow spots on the abdomen of the female of this species produce with the general colouring and shape a remarkable superficial resemblance to the female of the excessively abundant *Scolia quadripunctata.* When at rest upon a flower the insects could only be distinguished by careful observation. The resemblance is doubtless synaposematic, like that which obtains between the South African *Scolia alaris* and the Diploptera. (Trans. Ent. Soc. Lond., 1902, pp. 527–529.) Mr. A. H. Hamm

first pointed out this interesting example of Müllerian mimicry to me, and we both subsequently noticed it on several occasions. E. B. P.]

SALIUS, sp. (?).

Soller Pass: *June* 30.—1 ♀ A. H.

SALIUS PUSILLUS, Schiödte.

Soller Pass, upper half of S. zigzags: *July* 1.—1 ♀ A. H.

SALIUS PROPINQUUS, Lep.

Above Soller Pass: *July* 3.—1 ♀ E. B. P.

PSEUDAGENIA ALBIFRONS, Dhl.

Soller to Lluch: *July* 5.—1 ♀ E. B. P.
Lluch: *July* 6.—1 ♀ A. H.

PSEUDAGENIA CARBONARIA, Scop.

Soller Pass: *June* 29.—1 ♂ A. H. *June* 30.—1 ♀ E. B. P.
Above Soller Pass: *July* 3.—1 ♀ W. H., 1 ♀ A. H.
Soller Pass: *July* 1.—1 ♀ E. B. P.
Upper half of S. zigzags: *July* 1.—1 ♀ W. H.

CEROPALES MACULATUS, F.

Soller Pass: *June* 30.—2 ♀ W. H.
Road from Lluch to Pollensa: *July* 6.—1 ♀ W. H.
Little Albufera: *July* 8:—1 ♀ W. H. *July* 9.—1 ♀ A. H.

ASTATA BOOPS, Schr.

Soller Pass: *June* 30.—1 ♂ W. H.
Soller Pass, upper half of S. zigzags: *July* 1.—1 ♂ A. H.
Pollensa to Castillo del Rey: *July* 7.—1 ♀ E. B. P., 1 ♀ A. H.

NOTOGONIA POMPILIFORMIS, Pz.

Soller Pass: *June* 30.—1 ♀ A. H.
Road from Pollensa to Port: *July* 8.—1 ♀ A. H. *July* 9.—1 ♀ E. B. P.

TACHYSPHEX NITIDUS, Spin.

Near Porto Pi: *June* 27.—1 ♀ E. B. P.
Plain of Palma, road to Soller: *June* 29.—1 ♂ E. B. P.

Little Albufera: *July* 8.—1 ♀ A. H. *July* 9.—1 ♀ A. H.
Road from Pollensa to Port: *July* 8.—1 ♀ W. H., 2 ♀ A. H. *July* 9.—1 ♀ A. H.
Near Porto Pi: *July* 12.—1 ♀ E. B. P.

Some of these specimens differ considerably from others by the wide, smooth, almost impunctate space just above the anterior margin of the clypeus. I sent one of these to Prof. Kohl of Vienna, but he considers it merely as a variety of this species.

TACHYSPHEX, sp. (?) nr. *nitidus.*

Castillo del Rey: *July* 7.—1 ♀ A. H.

Puncturation of mesonotum finer and closer than in *nitidus.*

TACHYSPHEX FILICORNIS, Kohl.

Near Porto Pi: *July* 10.—1 ♂ W. H., 1 ♀ A. H. *July* 12.—1 ♀ W. H.

TRYPOXYLON ATTENUATUM, Sm.

Above Soller Pass: *July* 3.—1 ♂ A. H.
Pollensa Castillo del Rey: *July* 7.—1 ♀ A. H.
Near Porto Pi: *July* 12.—1 ♂ E. B. P.

PSAMMOPHILA HIRSUTA, Scop.

32 ♂, 12 ♀. *June* 26 to *July* 10.

PSAMMOPHILA TYDEI, Guill.

Near Porto Pi: *June* 27.—1 ♂ W. H. *July* 10.—1 ♂ A. H. *July* 12.—2 ♂ E. B. P., 2 ♂ W. H., 1 ♂, 1 ♀ A. H.
Near Palma, Lluchmayor Road: *June* 28.—1 ♂, 1 ♀ E. B. P., 2 ♂, 2 ♀ A. H.
Soller to Port: *July* 4.—1 ♂, 1 ♀ E. B. P.
Road from Pollensa to Port: *July* 8.—1 ♀ A. H.
Little Albufera: *July* 8.—1 ♂ E. B. P., 1 ♂ W. H., 2 ♀ A. H. *July* 9.—1 ♂, 2 ♀ E. B. P., 1 ♂ A. H.

SPHEX VIDUATUS, Chr.

Near Porto Pi: *June* 27.—1 ♀ E. B. P. *July* 12.—1 ♂ E. B. P., 1 ♂ W. H.

This is far from being a common species, but occurs in Algeria and S. Europe.

SPHEX SUBFUSCATUS, Dhl.

Near Palma, Lluchmayor Road: *June* 28.—1 ♀ E. B. P.
Above Soller Pass: *July* 3.—1 ♂ A. H.
Soller to Port: *July* 4.—1 ♂ A. H.
Road from Pollensa to Port: *July* 9.—1 ♀ W. H.
Castle Bellver, 400 ft.: *July* 11.—1 ♂ E B. P.

SPHEX FLAVIPENNIS, F.

Castle Bellver, 250–400 ft.: *June* 26.—1 ♀ A. H.
Soller Pass: *June* 30.—1 ♂ E. B. P. *July* 1.—1 ♀ E. B. P. *July* 2.—1 ♂, 1 ♀ A. H.
Above Soller Pass: *July* 3.—1 ♀ A. H.
Pollensa to Castillo del Rey: *July* 7.—2 ♀ E. B. P.

SCELIPHRON PENSILIS, Ltr.

Lluch: *July* 6.—1 ♂ A. H.
Lluch to Pollensa: *July* 6.—1 ♀ W. H.
Pollensa to Castillo del Rey: *July* 7.—1 ♀ W. H., 2 ♀ A. H.
Pollensa to Port: *July* 8.—1 ♀ E. B. P. *July* 9. —1 ♂ E. B. P.
Near Porto Pi: *July* 12.—1 ♂ W. H.

SCELIPHRON SPIRIFEX, L. Common.

[Wherever mud was found these insects were seen collecting it for making their nests.

Both this species and the preceding, which is indistinguishable from it on the wing, present a very peculiar appearance during flight. The pale yellow parts of body and legs become invisible, while the black areas are extremely conspicuous. The limbs are probably so held during the flight of the insect that their yellow sections come beneath the median yellow of the body. However this may be the terminal black parts seem to be completely detached, suggesting the appearance of two insects, one pursuing the other, or a predaceous species carrying its prey. E. B. P.]

MIMESA PALLIDITARSIS, sp. nov.

Nigra, palpis, tibiarum posticarum basibus, tarsis-que omnibus flavis, capite thoraceque plus minus dense punctatis, antennarum articulis subtus valde carinatis, abdominis petiolo carinato, postpetiolo longiore.

♂. Black; the palpi, the extreme apex of all the tibiæ, the base of the posterior pair and all the calcaria and tarsi pale, the extreme apices of the femora pitchy, face densely clothed with silvery hairs with a slight golden tinge, vertex very densely and closely punctured, joints of the flagellum strongly carinated beneath, scape swollen, about equal in length to the 2nd joint of the flagellum, mesonotum shining, clothed with a sparse grey pubescence, deeply and somewhat closely punctured, the puncturation very close in front, less so on the disc and sides, where in certain positions indications of longitudinal rugosities can be seen, post-scutellum exceedingly finely and closely punctured, mesopleuræ finely punctured, sides of the metapleuræ and propodeum diagonally striate, propodeum above largely reticulate, its basal area very shining with a few large somewhat radiating costæ, wings slightly dusky, tegulæ and nervures piceous, legs sparingly clothed with greyish hairs; petiole of the basal segment of the abdomen longer than the post-petiole, clothed with long erect grey hairs, central keel slightly widening near its base, rest of the abdomen shining, finely and remotely punctured, clothed with very short greyish hairs, which are more conspicuous on the apices of the segments laterally; apical process of 8th segment testaceous.

Long. 7·8 mm.

Little Albufera: *July* 9.—1 ♂ E. B. P., 1 ♂ W. H., 2 ♂ A. H.

PEMPHREDON SHUCKARDI, Mor.

Little Albufera: *July* 9.—1 ♂ W. H.

PEMPHREDON LETHIFER, Shuck.

Soller Pass: *July* 2.—1 ♀ A. H.
Little Albufera: *July* 9.—1 ♀ A. H.

DIODONTUS FRIESEI, Kohl.

Near Palma, Lluchmayor Road: *June* 28.—1 ♂ A. H., 1 ♂ E. B. P.

Described from specimens from Palestine. Prof. Kohl has seen one of the specimens, and agrees in considering it as belonging to this species.

DIODONTUS MINUTUS, Fab.

Near Porto Pi: *July* 10.—1 ♀ E. B. P.

PASSALŒCUS INSIGNIS, V. de L.

Road from Pollensa to Port: *July* 8.—1 ♂ A. H.

GORYTES LÆVIS, Ltr.

Soller Pass: *June* 30.—1 ♀ W. H.
Near Porto Pi: *July* 12.—1 ♀ E. B. P.

GORYTES LATIFRONS, Spin.

Soller to Lluch: *July* 5.—1 ♀ A. H.

BEMBEX OCULATA, Ltr.

Near Porto Pi: *July* 10.—1 ♀ E. B. P., 1 ♂ A. H. *July* 12.—4 ♂ E. B. P., 1 ♀ W. H., 1 ♀ A. H.

[Flying very rapidly over the wet sand at the bottom of the little inlet. E. B. P.]

STIZUS TRIDENS, F.

Near Porto Pi: *June* 27.—1 ♂ A. H. *July* 12.—1 ♂ E. B. P., 1 ♀ A. H.
Soller to Port: *July* 4.—2 ♂ A. H.

PHILANTHUS TRIANGULUM, F.

June 26 to *July* 11.—49 ♂, 45 ♀.

[The females were often seen carrying bees to their nest, especially at Soller Pass, where a colony had excavated burrows in a heap of road scrapings. E. B. P.]

CERCERIS ARENARIA, L.

Abundant.

CERCERIS 4-CINCTA, V. de L.

Near Porto Pi: *June* 27.—3 ♂ E. B. P., 1 ♂ W. H. *July* 10.—1 ♀ A. H. *July* 12.—4 ♀ A. H.
Near Palma, Luchmayor Road: *June* 28.—2 ♂ E. B. P., 5 ♂, 1 ♀ A. H.
Plain of Palma, road to Soller: *June* 29.—2 ♀ A. H.
Soller Pass: *June* 30.—1 ♂, 1 ♀ E. B. P. *July* 2.—3 ♂ W. H., 1 ♀ A. H., 1 ♂ E. B. P. Upper half of S. zigzags: *July* 1.—1 ♀ E. B. P., 5 ♂ A. H. Below S. zigzags: *July* 1.—1 ♂ W. H.
Soller to Lluch: *July* 5.—1 ♀ E. B. P.
Lluch: *July* 6.—1 ♂, 1 ♀ E. B. P.
Road from Lluch to Pollensa: *July* 6.—1 ♂ A. H.

Pollensa to Castillo del Rey: *July* 7.—1 ♂ E. B. P.
Road from Pollensa to Port: *July* 8.—1 ♂ E. B. P.
Castle Bellver: *July* 11.—2 ♂ A. H.

CERCERIS FERRERI, V. de L.

Castle Bellver, 250–400 ft.: *June* 26.—1 ♂ E. B. P.
Near Porto Pi: *June* 27.—1 ♂ E. B. P., 2 ♂, 1 ♀ A. H.
Near Palma Lluchmayor Road: *June* 28.—1 ♂ A. H.
Soller Pass: *June* 30.—3 ♂, 2 ♀ E. B. P. *July* 1.—1 ♀ E. B. P. *July* 2.—1 ♂ A. H.
Soller Pass, upper half S. zigzags: *July* 1.—1 ♂ A. H.
Above Soller Pass: *July* 3.—1 ♀ A. H.
Soller to Port: *July* 4.—1 ♂ A. H.
Little Albufera: *July* 8.—1 ♀ E. B. P., 1 ♀ A. H.

CERCERIS EMARGINATA, Pz.

♂ and ♀ common.

OXYBELUS LAMELLATUS, Oliv.

Little Albufera: *July* 9.—1 ♀ W. H.

CRABRO HYPSÆ, de Stef. ♀, *punctatus*, H.-Sch. (nec Lep.?).

Soller to Lluch: *July* 5.—1 ♀ A. H.
Road from Pollensa to Port: *July* 9.—1 ♀ W. H.
Near Porto Pi: *July* 10.—1 ♀ B. P.

For this determination I am indebted to Prof. Kohl, who tells me that it is certainly *hypsæ* of de Stefani, and certainly *punctatus*, H.-Schaeffer, but that it is doubtful if it is the *punctatus* of Lepeletier.

CRABRO VAGUS, L., var. *sulphuripes*, Sm.

Plain of Palma, road to Soller: *June* 29.—3 ♂, 1 ♀ A. H., 1 ♂ W. H.
Soller Pass: *June* 30.—2 ♂ W. H. *July* 2.—2 ♂ W. H. Upper half of S. zigzags: *July* 1.—1 ♂ W. H. Below S. zigzags: *July* 1.—1 ♂ W. H.
Little Albufera: *July* 9.—1 ♂ E. B. P., 1 ♂ W. H.

CRABRO ELONGATULUS, V. de L., var. *femoribus anticis subtus barbatis.*

Near Palma, Lluchmayor Road: *June* 28.—2 ♂, 1 ♀ E. B. P., 1 ♂, 2 ♀ A. H.

CRABRO 5-NOTATUS, Jur.

Soller to Lluch: *July* 5.—2 ♀ A. H.

VESPA GERMANICA, F.

Soller Pass: *June* 30.—1 ♀ W. H. *July* 1.—1 ♀ E. B. P.

Above Soller Pass: *July* 2.—1 ♀ E. B. P.

Soller to Port: *July* 4.—1 ♀ E. B. P.

[The rarity of this species was noteworthy. Only females were seen. E. B. P.]

POLISTES GALLICA, L.

Abundant everywhere.

[After *Halictus scabiosæ*, this was the most abundant Aculeate in the island. E. B. P.]

EUMENES COARCTATA, L.

Fairly abundant everywhere.

RHYNCHIUM OCULATUM, F.

Soller to Port: *July* 4.—1 ♂ E. B. P., 1 ♂ A. H.

Pollensa, on vine behind Fonda: *July* 7.—1 ♀ W. H.

Pollensa to Castillo del Rey: *July* 7.—1 ♂ W. H., 2 ♂, 2 ♀ A. H.

Little Albufera: *July* 9.—1 ♀ A. H.

ODYNERUS DANTICI, Rossi, var.

Near Porto Pi: *June* 27.—1 ♂ E. B. P., 1 ♂ A. H. *July* 10.—1 ♂ W. H. *July* 12.—1 ♂, 2 ♀ E. B. P., 3 ♂ W. H.

Near Palma, Luchmayor Road: *June* 28.—1 ♂, 1 ♀ E. B. P., 1 ♀ A. H.

Soller Pass: *June* 30.—1 ♂ E. B. P., 1 ♂ W. H. *July* 2.—1 ♂ A. H.

Little Albufera: *July* 8.—2 ♀ E. B. P.

A rather small form of this very variable species.

ODYNERUS SIMPLEX, F.

Castle Bellver, 250–400 ft.: *June* 26.—1 ♂ W. H.

Soller Pass, below S. zigzags: *July* 1.—1 ♀ E. B. P., 1 ♂ A. H.

Road from Lluch to Pollensa: *July* 6.—1 ♂ A. H.

Road from Pollensa to Port: *July* 8.—1 ♀ W. H., 1 ♀ A. H. *July* 9.—1 ♀ A. H.

ODYNERUS PARIETUM, Linn.

Abundant.

ODYNERUS PARIETUM, Linn., var. *renimacula.*

Soller Pass: *June* 30.—1 ♀ A. H. Upper half of S. zigzags: *July* 1.—1 ♀ A. H. Below S. zigzags: *July* 1.—3 ♀ E. B. P., 1 ♀ W. H. Above Soller Pass: *July* 3.—1 ♂ W. H.

[This variety was thus, within the limits of our experience, confined to the vicinity of Soller Pass. E. B. P.]

ODYNERUS ALPESTRIS, Sauss.

Castle Bellver, 250–400 ft.: *June* 26.—2 ♀ A. H.
Near Porto Pi: *June* 27.—2 ♀ W. H., 2 ♀ A. H. *July* 10.—2 ♂, 2 ♀ E. B. P., 3 ♀ A. H. *July* 12.—2 ♂, 3 ♀ E. B. P., 2 ♂, 3 ♀ W. H., 2 ♂, 2 ♀ A. H.

ODYNERUS SICULUS, de Stef. (?).

Road from Pollensa to Port: *July* 8.—1 ♂ E. B. P. *July* 9.—1 ♀ A. H.
Near Porto Pi: *July* 10.—1 ♂ A. H. *July* 12.—1 ♀ E. B. P., 1 ♂ W. H., 3 ♂, 1 ♀ A. H.
Castle Bellver, 250–400 ft.: *July* 11.—1 ♂ A. H.

PROSOPIS VARIEGATA, F.

Castle Bellver, 250–400 ft.: *June* 26.—1 ♂, 2 ♀ E. B. P., 2 ♂, 6 ♀ W. H., 1 ♀ A. H. *July* 11.—1 ♀ W. H., 1 ♂, 1 ♀ A. H.
Near Porto Pi: *June* 27.—1 ♂ E. B. P., 2 ♂, 2 ♀ A. H. *July* 11.—1 ♀ W. H.
Near Palma, Lluchmayor Road: *June* 28.—1 ♀ E. B. P.
Base of Monte Sentuiri: *July* 6.—1 ♀ A. H.

PROSOPIS MASONI, Ed. Saund.

Castle Bellver, 250–400 ft.: *June* 26.—1 ♂ E. B. P., 1 ♂ A. H.
Near Porto Pi: *June* 27.—1 ♂ A. H. *July* 12.—1 ♂, 1 ♀ A. H.
Near Palma, Lluchmayor Road: *June* 28.—1 ♀ E. B. P.
Soller Pass: *June* 30.—1 ♀ E. B. P.
Above Soller Pass: *July* 3.—1 ♀ E. B. P.

Lluch: *July* 6.—1 ♀ W. H.
Road from Lluch to Pollensa: *July* 6.—1 ♂ E. B. P., 2 ♀ A. H.
Pollensa to Castillo del Rey: *July* 7.—2 ♂, 1 ♀ E. B. P., 2 ♂, 7 ♀ A. H.
Road from Pollensa to Port: *July* 8.—1 ♂ W. H.

PROSOPIS PICTA, Sm.

Soller Pass: *June* 30.—1 ♀ W. H.
Soller to Port: *July* 4.—1 ♂ E. B. P., 1 ♂ A. H.
Soller to Lluch: *July* 5.—1 ♀ E. B. P.
Little Albufera: *July* 9.—1 ♂ W. H.

PROSOPIS CLYPEARIS, Schenck.

Near Porto Pi: *June* 27.—1 ♂ A. H. *July* 12.—1 ♀ A. H.
Soller to Lluch: *July* 5.—1 ♂ W. H., 2 ♀ A. H.
Pollensa to Castillo del Rey: *July* 7.—1 ♀ E. B. P., 2 ♀ A. H.
Road from Pollensa to Port: *July* 8.—1 ♀ W. H.

PROSOPIS PICTIPES, Nyl.

Castle Bellver, 250–400 ft.: *June* 26.—1 ♀ W. H.
Soller Pass: *June* 30.—1 ♀ A. H.
Near Porto Pi: *July* 12.—1 ♂ E. B. P.

PROSOPIS IMPARILIS, Först.

Road from Lluch to Pollensa: *July* 6.—1 ♂ A. H.
Pollensa to Castillo del Rey: *July* 7.—2 ♂ E. B. P., 2 ♂ A. H.

SPHECODES GIBBUS, L., var.

Palma, Road to Lluchmayor: *June* 28.—4 ♂ E. B. P., 1 ♂ 1 ♀ A. H.
Soller Pass: *June* 29.—1 ♂ W. H. *June* 30.—2 ♂ A. H. *July* 1.—1 ♀ E. B. P. *July* 2.—1 ♂ A. H.
Above Soller Pass: *July* 3.—1 ♂ A. H.
Soller to Port: *July* 4.—2 ♂ A. H.
Soller to Lluch: *July* 5.—1 ♂ W. H., 1 ♀ A. H.
Pollensa to Castillo del Rey: *July* 7.—2 ♂ A. H.
Near Porto Pi: *July* 10.—1 ♂ A. H. *July* 12.—2 ♂ E. B. P., 5 ♂ W. H.

In all the specimens the abdomen is entirely red, and the posterior tibiæ red in both sexes. The armature, however, is that of typical *gibbus*.

Sphecodes subquadratus, Sm.

Common.

Sphecodes puncticeps, Thoms.

Near Porto Pi: *June* 27.—1 ♂ A. H. *July* 12.—1 ♂ E. B. P.
Soller Pass, upper half of S. zigzags: *July* 1.—1 ♀ E. B. P.
Pollensa to Castillo del Rey: *July* 7.—1 ♂ A. H.
Road from Pollensa to Port: *July* 9.—1 ♂ A. H.

Halictus scabiosæ, Rossi, ♂ ♀, and var. *ochraceovittatus*, Dours.

Abundant everywhere.

The majority of the ♂ ♂ belong to the smaller form, which I believe to be identical with *ochraceovittatus*, Dours.

[This was by far the most abundant Aculeate in the island. E. B. P.]

Halictus separandus, Schm.

Castle Bellver, 250–400 ft.: *June* 26.—1 ♂ E. B. P., 1 ♀ W. H., 1 ♂ A. H.
Near Porto Pi: *June* 27.—1 ♀ E. B. P. *July* 10.—1 ♂ E. B. P. *July* 12.—1 ♀ W. H., 1 ♂ A. H.
Near Palma, Lluchmayor Road: *June* 28.—2 ♂ A. H.
Lluch: *July* 6.—1 ♂ A. H.

Halictus malachurus, Kirb.

Abundant.

Halictus villosulus, Kirb.

Pollensa to Castillo del Rey: *July* 7.—3 ♂ E. B. P.
Near Porto Pi: *July* 12.—1 ♂ E. B. P.

Halictus brevicornis, Schk.

Soller Pass, upper half of S. zigzags: *July* 1.—1 ♀ E. B. P.
Soller Pass: *July* 2.—1 ♀ A. H.
Above Soller Pass: *July* 3.—2 ♀ A. H.

Soller to Lluch: *July* 5.—1 ♀ A. H.
Road from Lluch to Pollensa: *July* 6.—1 ♀ A. H.
Pollensa to Castillo del Rey: *July* 7.—2 ♀ A. H.

These specimens are slightly different from those of this species which occur further north, in having the punc-turation of the mesonotum stronger and more regular.

HALICTUS PUNCTATISSIMUS, Mor.

Near Porto Pi: *June* 27.—1 ♂ E. B. P.
Near Palma, Lluchmayor Road: *June* 28.—1 ♂ A. H.
Soller Pass, upper half of S. zigzags: *July* 1.—1 ♂ A. H.
Soller to Lluch: *July* 5.—1 ♂ A. H.

HALICTUS DUBITABILIS, sp. nov.

H. punctatissimo affinis, sed multo minor, ♂ capite valde elongato clypeo minus producto, antennis pallidis, ♀ capite breviore clypeo minus producto, propodeo nitidiore striis basalibus brevioribus, distinctus.

♂. Face very elongate, about twice as long as its greatest width between the eyes, antennæ long, reaching, when the head is in a horizontal position, to about the apex of the propodeum, the joints of the flagellum longer than wide, slightly swollen beneath, testaceous and scarcely black even posteriorly. Mesonotum nearly dull, closely punctured propodeal area radiately rugose, wing nervures and tegulæ pale testaceous, legs clothed with greyish-white hairs, abdomen slightly shining closely and distinctly punctured on the 1st and 2nd segments, indefinitely on the rest, beneath with a few longish hairs on the discs of the segments.

♀ exceedingly like a diminutive *punctatissimus* but the face is rather shorter, the clypeus not being so much produced; the mesonotum is duller and rather more closely punctured, the propodeum more shining with more regular and shorter longitudinal striæ at the base, beyond which the brow is smooth and shining, its apical margin subtruncate, abdomen punctured much as in *punctatissimus.*
Long. 5 m.m.

A species with the general facies of *punctatissimus* but much smaller, black, clothed sparingly with greyish-white hairs, the ♂ with the antennæ beneath, the apex of the clypeus, the labrum, mandibles, the tibiæ at their base and apex and the tarsi pale testaceous.

Near Palma, Lluchmayor Road: *June* 28.—2 ♂ A. H.
Road from Lluch to Pollensa: *July* 6.—1 ♂ A. H.
Pollensa to Castillo del Rey: *July* 7.—3 ♀ A. H.
Road from Pollensa to Port: *July* 8.—9 ♂ E. B. P., 1 ♂ W. H., 4 ♂ 1 ♀ A. H.
Little Albufera: *July* 8.—1 ♀ W. H., 1 ♀ A. H. *July* 9.—1 ♂ 1 ♀ W. H., 1 ♀ E. B. P.
Near Porto Pi: *July* 10.—1 ♂ W. H. *July* 12.—2 ♂ A. H.

HALICTUS HOLLANDI, sp. nov.

H. minutissimo affinis, facie longiore, mesonoto minus dense punctato nitidiore, antice linea longitudinali breviore minus fortiter impressa, abdominis segmento basali punctato, distinguendus.

♂ black, apex of clypeus, labrum and mandibles flavous, antennæ beneath, tegulæ and the base of the tibiæ pale, tarsi more or less piceous, head rather shining, strongly punctured, face rather elongate, clothed with white pubescence, clypeus scarcely produced, antennæ somewhat thick, the joints slightly swollen. Mesonotum shining, seen under a strong lens to be microscopically rugulose, not closely but distinctly and rather finely punctured, propodeum rounded posteriorly its brow rather callous and shining, basal area impressed and irregularly and longitudinally rugose, wings hyaline, nervures brown, legs clothed with white hairs; abdomen shining, sparingly clothed, especially at the sides and apex, with short white hairs. Apices of the 1st and 2nd segments very deeply impressed, making the segments very convex, in this respect much resembling *minutissimus*. Puncturation fine and even on the 1st and 2nd, more confused and irregular on the rest of the segments, there is a slight trace of a white pubescent basal band on the 2nd.

♀ sub-elongate and very like *minutissimus* in general shape, entirely black, sparingly clothed with white hairs, face rather elongate, more or less approaching the form of *punctatissimus*, etc., face dull very closely punctured, vertex shining and less closely so, clypeus largely punctured, but scarcely shining, mesonotum shining, with a distinct and well-defined puncturation on a finely rugulose surface, a well-marked central impression in front, propodeum, etc., as in the ♂, legs clothed with long white hairs, abdomen with the apices of the segments paler, basal segment very shining, finely and remotely punctured, the rest duller and closely so, 2nd segment with a very slight indication of a lateral white pubescent spot at the base.

Long. 4–4½ m.m.

Closely allied to *minutissimus*, but with a longer face, more shining and rather less closely punctured mesonotum, the central impression of which is shorter and less deep, and with the basal segment of the abdomen punctured; the propodeum also is narrower and its sides more convergent.

I have named this species in honour of Mr. W. Holland, who has done so much excellent work on the British insect fauna, and especially the Coleoptera.

Road from Pollensa to Port: *July* 8.—2 ♂ E. B. P.
Little Albufera: *July* 9.—4 ♀ E. B. P., 2 ♂ W. H.

HALICTUS MUCOREUS, Ev.

MALES.

Castle Bellver, 250–400 ft.: *June* 26.—1 ♂ W. H.
Near Porto Pi: *June* 27.—1 ♂ E. B. P., 2 ♂ W. H. *July* 10.—4 ♂ E. B. P., 3 ♂ W. H., 7 ♂ A. H. *July* 11.—1 ♂ E. B. P. *July* 12.—2 ♂ W. H.

FEMALES.

Castle Bellver, 250–400 ft.: *June* 26.—1 ♀ E. B. P., 2 ♀ W. H. *July* 11.—2 ♀ A. H.
Near Porto Pi: *June* 27.—5 ♀ E. B. P., 5 ♀ W. H., 9 ♀ A. H. *July* 10.—3 ♀ E. B. P., 6 ♀ W. H., 3 ♀ A. H. *July* 12.—2 ♀ E. B. P., 4 ♀. W. H., 9 ♀ A. H.
Near Palma, Lluchmayor Road: *June* 28.—1 ♀ A. H.
Plain of Palma, Road to Soller: *June* 29.—1 ♀ E. B. P.
Above Soller Pass: *July* 3.—1 ♀ W. H.

HALICTUS PULVEREUS, Mor.

Near Porto Pi: *July* 10.—1 ♂ A. H. *July* 11.—1 ♂ W. H. *July* 12.—1 ♀ A. H.
Castle Bellver, 250–400 ft.: *July* 11.—2 ♂ E. B. P., 5 ♂, 1 ♀ A. H.

HALICTUS GEMMEUS, Dours.

9 ♂, 170 ♀. Fairly common everywhere.

HALICTUS HAMMI, sp. nov.

Æneo-viridis, nitidus, segmentorum abdominis apicibus testaceis Maris caput maximum clypei apice, tibiarum basi et apice tarsisque totis flavis, propodei area subtriangulari longitudinaliter rugosa.

Bronzy-green, sparingly clothed with white hairs, legs and antennæ black, apical margin of the abdominal segments widely pale in the ♀ narrowly in the ♂, in which latter sex a spot at the apex of the clypeus, the base and apex of the tibæ and all the tarsi, except their apical joints, are pale yellowish white.

♂ head very large, wider considerably than the thorax, dull, and very finely and closely punctured, face across the eyes longer than wide, cheeks somewhat angularly produced above the base of the mandibles, clypeus and centre of face below the antennæ shining and more largely punctured, with a yellow spot at the apex, the colour extending a little backwards in a central line. Eyes scarcely converging, antennæ black, the joints slightly swollen beneath, those of the flagellum beyond the 3rd, about once and a quarter as long as wide; mesonotum shining, closely punctured but much less so than the head, tegulæ pale, wings hyaline with brown nervures, the stigma paler, propodeum with a well-defined subtriangular basal area, which is irregularly and longitudinally rugose, sides of the propodeum rugosely punctured; abdomen very shining, not very closely punctured, the 2nd and 3rd segments with a basal patch of white pubescence on each side, the 1st and 2nd rather deeply impressed at the apex laterally, apices of the segments beneath simple, widely pale, the 6th, at any rate as much as is visible in this specimen, testaceous, legs clothed with short white hairs.

♀ in sculpture resembling the ♂, eyes more convergent, pale bands at the apices of the segments very broad, the apical rima and sides of the 5th segment also pale, 2nd and 3rd segments with lateral white pubescent spots at the base as in the ♂, 4th with a continuous band, tibiæ narrowly paler at the base and apex, 2nd segment beneath with very long pale hairs.

Long. 5·6 m.m.

Allied to *Smeathmanellus* but differing in the pale tarsi, etc., of the ♂ and the puncturation and pale apical margins of the segments in the ♀. It is also closely allied to *simulans*, Perez, but the propodeal area is striate or vaguely so, and the apices of the abdominal segments are not punctate as they are said to be in that species.

This species is named in honour of Mr. A. H. Hamm, who has done so much in collecting and observing the British Aculeate Hymenoptera.

Soller Pass, zigzags to Soller: *July* 4.—1 ♂, 1 ♀ A. H.

Soller to Port: *July* 4.—1 ♀ A. H.

Soller to Lluch: *July* 5.—1 ♀ W. H.
Pollensa to Castillo del Rey: *July* 7.—1 ♀ E. B. P.

HALICTUS SPHECODIMORPHUS, Vach.

Soller Pass: *June* 30.—1 ♀ W. H.

NOMIOIDES PULCHELLA, Schk.

Near Porto Pi: *June* 27.—1 ♂ W. H., 5 ♂ A. H. *July* 10.—4 ♂ E. B. P., 9 ♂, 1 ♀ A. H. *July* 12.—1 ♀ E. B. P., 5 ♂, 6 ♀ A. H.
Castle Bellver, 250–400 ft.: *July* 11.—10 ♂, 1 ♀ A. H.

NOMIOIDES VARIEGATA, Oliv.

Near Porto Pi: *July* 10.—1 ♀ E. B. P., 1 ♀ A. H. *July* 12.—6 ♀ A. H.

ANDRENA MORIO, Brullé.

Bellver Castle, 250–400 ft.: *June* 26.—1 ♀ W. H.
Near Porto Pi: *June* 27.—1 ♀ E. B. P.
Near Palma, Lluchmayor Road: *June* 28.—1 ♀ E. B. P., 1 ♂ A. H.
Soller Pass: *June* 30.—1 ♀ E. B. P. *July* 2.—1 ♀ A. H.
Soller Pass, upper half of S. zigzags: *July* 1.—1 ♂ W. H.

ANDRENA BOYERELLA, Dours. (?).

Above Soller Pass: *July* 3.—1 ♀ W. H.
Soller to Lluch: *July* 5.—2 ♀ W. H.

ANDRENA FULVICRUS, Kirb.

Castle Bellver, 250–400 ft.: *June* 26.—2 ♀ A. H.
Near Palma, Lluchmayor Road: *June* 28.—2 ♂ E. B. P.
Above Soller Pass: *July* 3—1 ♀ A. H.

ANDRENA, sp. (?). Allied to *minutula*.

Pollensa to Castillo del Rey: *July* 7.—2 ♂ A. H.

ANDRENA ALBOFASCIATA, Thoms. (?).

Near Porto Pi: *June* 27.—1 ♀ E. B. P.
Near Palma, Lluchmayor Road: *June* 28.—1 ♂, 1 ♀ E. B. P., 3 ♀ A. H.

Soller Pass: *June* 29.—1 ♀ W. H., 4 ♀ A. H. *June* 30.—5 ♀ E. B. P., 1 ♂ W. H., 1 ♀ A. H. *July* 2.—1 ♀ W. H., 1 ♂, 5 ♀ A. H. *July* 4.—5 ♂, 12 ♀ E. B. P.

Soller Pass, upper half of S. zigzags: *July* 1.—2 ♀ E. B. P., 8 ♀ W. H., 2 ♂, 5 ♀ A. H.

Above Soller Pass: *July* 2.—2 ♀ E. B. P. *July* 3.—1 ♀ E. B. P., 4 ♀ A. H.

Soller to Port: *July* 4.—1 ♂ A. H.

Soller to Lluch: *July* 5.—1 ♀ A. H.

Lluch: *July* 6.—1 ♀ E. B. P.

Road from Lluch to Pollensa: *July* 6.—1 ♂ A. H.

Pollensa to Castillo del Rey: *July* 7.—3 ♂, 1 ♀ E. B. P.

These are all, I believe, referable to what Schmiedeknecht describes as Thomson's species, and he mentions the Balearic Isles as a locality from which he has received it; probably it may be only a white-haired form of *Afzeliella*.

NOMIA RUFICORNIS, Luc.

Castle Bellver, 250–400 ft.: *June* 26.—1 ♂, 1 ♀ W. H. *July* 11.—1 ♀ A. H.

Near Palma, Lluchmayor Road: *June* 28.—1 ♂ E. B. P.

Road from Luch to Pollensa: *July* 6.—1 ♂ A. H.

Near Porto Pi: *July* 12.—1 ♂ W. H.

NOMADA MEPHISTO, Sch., ♀.

Near Palma, Lluchmayor Road: *June* 28.—1 ♀ A. H.

A fine, rare species.

PASITES MACULATUS, Jur.

Near Porto Pi: *June* 27.—1 ♀ A. H. *July* 12.—1 ♂ A. H.

CERATINA CUCURBITINA, Rossi.

Common. (All females.)

CERATINA PARVULA, Sm.

Road from Lluch to Pollensa: *July* 6.—1 ♀ A. H.

This is, I believe, the first record of this little species from the Balearic Isles. It was originally described from Albania.

CERATINA DALLATORREANA, Friese.

ALL FEMALES.

Near Porto Pi: *June* 27.—2 ♀ A. H. *July* 12.—1 ♀ E. B. P., 1 ♀ A. H.
Near Palma, Lluchmayor Road: *June* 28.—1 ♀ E. B. P.
Lluch: *July* 6.—1 ♀ W. H., 1 ♀ A. H.
Road from Lluch to Pollensa: *July* 6.—2 ♀ W. H., 3 ♀ A. H.
Pollensa to Castillo del Rey: *July* 7.—1 ♀ E. B. P.
Road from Pollensa to Port: *July* 8.—1 ♀ E. B. P., 5 ♀ W. H., 4 ♀ A. H. *July* 9.—2 ♀ E. B. P.

XYLOCOPA VIOLACEA, L.

Castle Bellver, 250–400 ft.: *June* 26.—1 ♀ W. H.
Soller Pass, upper half of S. zigzags: *July* 1.—1 ♀ E. B. P.
Above Soller Pass: *July* 2.—1 ♂, 6 ♀ E. B. P. *July* 3.—1 ♀ E. B. P.
Soller Pass: *July* 4.—1 ♀ E. B. P.
Soller to Lluch: *July* 5.—3 ♀ W. H., 1 ♀ A. H.
Lluch: *July* 6.—3 ♀ E. B. P., 2 ♀ W. H.
Road from Lluch to Pollensa: *July* 6.—1 ♀ E. B. P., 1 ♀ W. H.
Pollensa to Castillo del Rey: *July* 7.—4 ♀ W. H.
Little Albufera: *July* 9.—4 ♀ E. B. P.
Near Porto Pi: *July* 10.—1 ♀ A. H.

CŒLIOXYS AFRA, Lep.

Near Porto Pi: *June* 27.—1 ♀ A. H. *July* 12.—1 ♀ W. H.
Above Soller Pass: *July* 2.—1 ♂ E. B. P.
Soller to Port: *July* 4.—1 ♀ E. B. P.
Lluch: *July* 6.—1 ♂ W. H.
Pollensa to Castillo del Rey: *July* 7.—3 ♂ E. B. P., 1 ♂, 1 ♀ A. H.
Road from Pollensa to Port: *July* 8.—1 ♂ W. H. *July* 9.—1 ♂ W. H.
Castle Bellver, 250–400 ft.: *July* 11.—1 ♂ A. H.

CŒLIOXYS ACUMINATA, Nyl.

Pollensa to Castillo del Rey: *July* 7.—1 ♀ E. B. P.

Apical ventral valve with an unusually blunt apex.

CHALICODOMA SICULA, Rossi.

Road from Lluch to Pollensa: *July* 6.—3 ♀ W. H.
Pollensa to Castillo del Rey: *July* 7.—3 ♀ E. B. P., 1 ♀ W. H.

[All specimens much worn. Both males and females of this species were very abundant and in beautiful condition at the end of March and beginning of April in 1900 (E. M. M., Sept. 1901, p. 210). Only a few very worn females were seen three months later in 1901. E. B. P.]

MEGACHILE SERICANS, Fonsc.

Near Porto Pi. Extremely abundant July 10–12, although also seen earlier.
Near Palma, Lluchmayor Road: *June* 28.—2 ♀ E. B. P., 2 ♀ A. H.
Soller Pass: *June* 30.—1 ♂ E. B. P. Above Soller Pass: *July* 3.—1 ♀ W. H.
Soller to Lluch: *July* 5.—1 ♂ E. B. P.
Lluch: *July* 6.—1 ♀ W. H.
Pollensa to Castillo del Rey: *July* 7.—3 ♂ E. B. P., 3 ♂, 1 ♀ W. H., 4 ♂ A. H.
Castle Bellver, 250–400 ft.: *July* 11.—1 ♂ E. B. P., 1 ♂ W. H.

[The female when she first alights on a flower raises and shakes her abdomen, exposing the red scopa and rendering it remarkably conspicuous. She stings very freely, and the display is probably aposematic. E. B. P.]

MEGACHILE CENTUNCULARIS, L.

Soller Pass: *June* 29.—1 ♀ A. H.
Little Albufera: *July* 9.—1 ♂ E. B. P.

MEGACHILE ARGENTATA, Ltr.

Common.

MEGACHILE ROTUNDATA, F.

Near Porto Pi: *June* 27.—1 ♀ E. B. P.
Road from Pollensa to Port: *July* 9.—1 ♀ W. H.

MEGACHILE APICALIS, Spin.

Frequent.

ANTHIDIUM MANICATUM, Ltr.

Castle Bellver, 250–400 ft.: *June* 26.—1 ♀ E. B. P., 3 ♂, 3 ♀ W. H., 1 ♂, 2 ♀ A. H. *July* 11.—2 ♂, 4 ♀ E. B. P.

Near Porto Pi: *June* 27.—1 ♂, 1 ♀ W. H., 2 ♂ A. H. *July* 11.—1 ♀ W. H.
Near Palma, Lluchmayor Road: *June* 28.—1 ♂, 1 ♀ E. B. P., 5 ♂, 4 ♀ A. H.
Lluch: *July* 6.—2 ♂, 2 ♀ W. H., 1 ♀ A. H.

Anthidium cingulatum, Ltr.

Common.

Anthidium florentinum, F.

Castle Bellver, 250–400 ft.: *June* 26.—2 ♂, 4 ♀ W. H.

Anthidium 7-dentatum, Ltr.

Castle Bellver, 250–400 ft.: *June* 26.—1 ♀ E. B. P.
Soller Pass: *June* 29.—1 ♀ A. H. *June* 30.—1 ♀ W. H. *July* 2.—1 ♀ A. H.
Soller Pass, upper half of S. zigzags: *July* 1.—1 ♂ W. H., 1 ♂, 1 ♀ A. H.
Above Soller Pass: *July* 2.—1 ♂ E. B. P. *July* 3.—1 ♀ E. B. P., 1 ♀ W. H.
Soller to Lluch: *July* 5.—3 ♂ E. B. P.
Road from Lluch to Pollensa: *July* 6.—1 ♀ W. H.
Base of Monte Sentuiri: *July* 6.—1 ♂ W. H., 1 ♂ A. H.
Pollensa to Castillo del Rey: *July* 7.—1 ♀ W. H., 1 ♀ A. H.
Near Porto Pi: *July* 11.—1 ♂ W. H.

Anthidium lituratum, Pz.

Road from Lluch to Pollensa: *July* 6.—1 ♀ A. H.
Pollensa to Castillo del Rey: *July* 7.—1 ♀ A. H.

Eriades crenulatus, Nyl.

Castle Bellver, 250–400 ft.: *June* 26.—1 ♀ A. H.
Near Porto Pi: *June* 27.—1 ♂ W. H.
Near Palma, Lluchmayor Road: *June* 28.—1 ♂ E. B. P., 3 ♀ A. H.
Lluch: *July* 6.—1 ♀ E. B. P., 1 ♀ W. H.
Road from Lluch to Pollensa: *July* 6.—1 ♀ E. B. P., 1 ♀ W. H., 1 ♂, 3 ♀ A. H.
Pollensa to Castillo del Rey: *July* 7.—2 ♂, 1 ♀ E. B. P., 2 ♂, 1 ♀ A. H.

Eriades rubicolus, Per.

Near Palma, Lluchmayor Road: *June* 28.—2 ♂, 5 ♀ E. B. P., 3 ♀ A. H.
Plain of Palma, road to Soller: *June* 29.—1 ♀ A. H.
Lluch: *July* 6.—2 ♀ W. H., 1 ♂, 2 ♀ A. H.
Road from Lluch to Pollensa: *July* 6.—2 ♀ A. H.
Base of Monte Sentuiri: *July* 6.—1 ♀ A. H.
Pollensa to Castillo del Rey: *July* 7.—2 ♂ A. H.
Road from Pollensa to Port: *July* 9.—1 ♀ A. H.
Near Porto Pi: *July* 10.—1 ♂ A. H.

Osmia notata, F.

Near Porto Pi: *June* 27.—1 ♀ A. H.
Near Palma, Lluchmayor Road: *June* 28.—6 ♀ A. H.
Soller Pass, upper half of S. zigzags: *July* 1.—2 ♀ E. B. P., 1 ♀ W. H.
Soller Pass: *July* 2.—1 ♀ A. H.
Above Soller Pass: *July* 3.—1 ♀ A. H.
Soller to Lluch: *July* 5.—4 ♀ E. B. P., 6 ♀ A. H.

Osmia cœrulescens, L.

Near Palma, Lluchmayor Road: *June* 28.—1 ♀ A. H.
Road from Lluch to Pollensa: *July* 6.—1 ♀ A. H.
Pollensa to Castillo del Rey: *July* 7.—2 ♀ W. H.

Osmia aurulenta, Pz.

Above Soller Pass: *July* 3.—1 ♀ (worn) W. H.

Osmia adunca, Ltr.

Castle Bellver, 250–400 ft.: *June* 26.—4 ♀ E. B. P.
Near Palma, Lluchmayor Road: *June* 28.—6 ♀ E. B. P., 8 ♀ A. H.
Lluch: *July* 6.—1 ♀ W. H., 2 ♀ A. H.
Road from Lluch to Pollensa: *July* 6.—1 ♂ E. B. P., 4 ♀ W. H.
Pollensa to Castillo del Rey: *July* 7.—2 ♀ E. B. P., 2 ♀ W. H.

Osmia tridentata, Duf. Perr.

Road from Lluch to Pollensa: *July* 6.—1 ♀ (worn), W. H.

CROCISA RAMOSA, Lep.

Castle Bellver, 250–400 ft.: *June* 26.—1 ♀ E. B. P.
Near Porto Pi: *June* 27.—1 ♂ W. H. *July* 10.—1 ♂ A. H. *July* 12.—1 ♂ E. B. P.
Near Palma, Lluchmayor Road: *June* 28.—1 ♀ A. H
Soller Pass, upper half of S. zigzags: *July* 1.—3 ♂ W. H.
Above Soller Pass: *July* 2.—1 ♂ E. B. P.
Soller to Port: *July* 4.—1 ♂ E. B. P., 1 ♂ A. H.
Soller to Lluch: *July* 5.—2 ♂ E. B. P.
Lluch: *July* 6.—1 ♀ W. H., 1 ♂, 1 ♀ A. H.
Road from Lluch to Pollensa: *July* 6.—6 ♂ E. B. P., 2 ♂, 2 ♀ W. H., 2 ♂ A. H.
Pollensa to Castillo del Rey: *July* 7.—5 ♂ E. B. P., 2 ♀ W. H., 5 ♂, 2 ♀ A. H.
Road from Pollensa to Port: *July* 8.—1 ♂ E. B. P., 3 ♂ W. H. *July* 9.—2 ♀ E. B. P.
Little Albufera: *July* 8.—3 ♂ A. H.

PODALIRIUS ALBIGENUS, Lep.

Castle Bellver, 250–400 ft.: *June* 26.—2 ♀ W. H., 2 ♀ A. H.
Near Porto Pi: *June* 27.—2 ♀ E. B. P., 3 ♀ A. H.
Near Palma, Lluchmayor Road: *June* 28.—4 ♂, 2 ♀ E. B. P., 2 ♂, 1 ♀ A. H.
Soller to Port: *July* 4.—1 ♂ E. B. P.

PODALIRIUS 4-FASCIATUS, Vill.

Common.

EUCERA GRISEA, F.

Near Porto Pi: *June* 27.—2 ♀ E. B. P., 1 ♀ A. H.
Near Palma, Lluchmayor Road: *June* 28.—1 ♀ A. H.

[The remarks on *Chalicodoma sicula* (p. 620) apply to this species, of which the examples were also in an extremely worn condition. E. B. P.]

BOMBUS TERRESTRIS, L., var. *ferrugineus*, Schmied.

Castle Bellver: *June* 26.—4 ☿ W. H.
Near Porto Pi: *June* 27.—1 ☿ E. B. P.

Soller Pass: *June* 29.—1 ♂, 1 ☿ E. B. P., 1 ♂, 2 ☿ A. H. *June* 30.—1 ♂ A. H. Below S. zigzags: *July* 1.—1 ♂, 1 ♀ W. H. *July* 2.—1 ☿ A. H. Above Pass: *July* 2.—1 ♀, 1 ☿ E. B. P. *July* 3.—1 ♀ E. B. P., 2 ☿ W. H.
Soller to Port: *July* 4.—1 ♀, 1 ☿ E. B. P.
Little Albufera: *July* 9.—1 ☿ A. H.

[Many more were seen and not taken, especially on Soller Pass. E. B. P.]

APIS MELLIFICA, L.
Everywhere.

II. SPAIN (1901–2).

Introduction by E. B. POULTON, F.R.S.

A FEW specimens of four species of ants taken by the present writer near Barcelona in 1900 are included in this section, as well as the captures on July 17, 1901, at Cerbère, the French frontier station at the east end of the Pyrenees.

The number of specimens submitted to Mr. Saunders was much smaller than in the case of Majorca, being 1491 in the first instance, together with 187 which were looked upon as duplicates. The numbers from the various localities are as follows (see Table, p. 625)—

The number of specimens is thus considerably less than half those captured in Majorca (June 26 to July 12, 1901). On the other hand, the number of species from the mainland recognized by Mr. Saunders is far greater, being 205 as compared with 143. This marked difference is no doubt in part due to the wider range covered both in space and time on the mainland; but making all allowances it is probably chiefly the result of the more limited number of species in the island fauna. The relative peculiarity of the latter is also well seen in the fact that five of its species are described as new, and of these one only occurs in the mainland list, viz. *Halictus dubitabilis*. No other new species is described from the mainland, although both lists contain forms which may be new, but

Cerbère, July 17, 1901	179 specimens.
Port Bou, June 24, 1901	179 ,,
Barcelona, June 25, ,, July 13, ,, July 16 } 1901	310 ,,
Montserrat (including Monistrol), July 13–16, 1901	493 ,,
Duplicates chiefly from Port Bou and Barcelona, 1901	187 ,,
Sierra de Guadarrama, La Granja (July 20–26), and El Escorial (July 28), including a few from Segovia (July 27), Madrid (July 17), and Burgos (July 30) . . . . . } 1902	330 ,,
Total . .	1678 ,,

either obscure or represented by insufficient material. Only 73 species, or as nearly as possible half of the Majorcan species, are common to the two lists, so that altogether 275 species are distinguished in this memoir.

It would be rash to build much on a comparison of the lists of Aculeates obtained in such short visits, lists which are obviously very incomplete. Nevertheless, they probably contain the majority of the commonest species to be found at the times when the collections were made. A brief tabular statement (see p. 626) will show at a glance the groups which in our limited experience were found to be strongly or feebly developed in the island fauna as compared with the mainland.

A brief account of the chief characteristics of the localities on the mainland is given below. The order followed is that of the dates, beginning with the earliest.

1900.

In the wet and cold spring of 1900 I stayed at Barcelona for two or three days before visiting Majorca. On March 20 a little collecting was attempted at Vallvidrera, on the ridge of the hills behind the city. It was rather warmer

	No. of species in Majorcan list.	No. of species in mainland list.	Species common to both.
Ants . . .	11	16	7
Scolia . . .	2	7	2
Pompilus . .	16	8	2
Salius . . .	4	0	0
Ammophila . . (and *Psammophila*)	2	5	2
Sphex . . .	3	5	2
Bembex . . .	1	4	1
Cerceris . .	4	8	4
Oxybelus . .	1	4	1
Crabro . . .	4	2	1
Odynerus . .	5	8	4
Prosopis . .	6	10	5
Colletes . . .	0	6	0
Sphecodes . .	3	6	2
Halictus . .	13	25 (including *H. dubitabilis*, n. sp.)	7
Andrena . .	5	5	2
Ceratina . .	3	7	2
Megachile . .	5	11	4
Anthidium . .	5	8	4
Osmia . . .	5	7	3
Podalirius . .	2	9	2
Psithyrus . .	0	1	0
Bombus . .	1	5	1

than usual on that day, and *Eristalis* was seen upon the wing, but nearly the whole of the few captures were made

by turning over stones. The only Hymenoptera were ants belonging to four species. A visit to Montserrat, the locality which we found so rich in July 1901, yielded very few insects, and no Hymenoptera at all.

1901.

June 24.—Mr. W. Holland, Mr. A. H. Hamm, and I arrived at Port Bou, the Spanish frontier station in the Eastern Pyrenees, late at night on June 23. The next boat for Majorca did not leave until the evening of the 25th, so it was decided to spend the whole of the 24th collecting at Port Bou, instead of going on to Barcelona. First the bare hot slopes near the station were explored, and many insects captured; then, following a hint given by the proprietor of the hotel, we penetrated a valley running up into the hills behind the little port. At the bottom of the valley there was a stream with abundant and varied plants; but the slopes also were still green and afforded a rich collecting ground. Lepidoptera were by no means common, but of insects generally we saw far more than on any other occasion throughout the journey. It is a locality which would probably well repay a more extended visit.

June 25.—The train for Barcelona started early in the morning, so that no insects could be collected at Port Bou on this day. Barcelona was reached a few hours before the boat sailed, and a considerable number of insects were taken in waste ground upon which wild flowers were growing.

July 13.—We landed at Barcelona in the morning, and spent some hours collecting in waste ground. In the early afternoon we took the train for Montserrat. A few insects were caught at Monistrol (2200 ft.) while waiting for the cars of the funicular railway. The terminus on Montserrat was reached early in the evening in time for a little collecting. At the height of the terminus and Hospederia (about 3000 ft.) the vegetation was fresh and green, and the collecting most interesting, varied, and tolerably rich. The bramble blossoms were at their best and very attractive.

July 14.—The whole day was spent at about the height of the Hospederia and not far from it. The level mountain path which begins opposite the Hospederia was

explored for a considerable distance, and many productive spots were searched.

July 15.—This day was occupied in a walk to San Geronimo and the summit of the mountain (4000 ft.). Good collecting was found in a great variety of conditions—an alternation of bare rocky slopes, shady woods, and sunny valleys. Just below the summit rich collecting was found in the fine, open, grassy valley, at the head of which is the hermitage of San Geronimo.

July 16.—The collecting on this day was an exact repetition of that upon July 13, taken of course in the reverse order—at Montserrat, in the neighbourhood of the Hospederia, before starting; at Monistrol waiting for the main-line train; and at Barcelona in waste ground.

July 17.—We arrived at Cerbère, the French frontier station, at night, and collected for several hours next morning (17th). The vegetation was far more parched than at Port Bou three weeks before; but apart from this the hills were not so accessible, and the country in the neighbourhood of the station much cultivated and less favourable as a collecting ground. Nevertheless, we captured a large number of insects of several orders, conveying a fair idea of some dominant elements in the insect fauna about the middle of July.

Thus a successful expedition was brought to a successful close. The weather on the mainland was perfect, every day bringing cloudless skies and bright sun.

1902.

To pass from the cold, sunless summer of 1902 in England to the glaring light and heat of Madrid was a contrast too sharp for human nature to bear with equanimity; so, after capturing a few insects in the Park on July 17, I took the advice of my kind friends Señor Don Ignacio Bolivar and Mr. G. C. Champion and started for La Granja (San Ildefonso) in the Sierra Guadarrama. This little town, with an altitude of about 4000 ft., possesses, at any rate in the month of July, the most delightful atmosphere and climate. During the whole visit there was neither rain nor cloud to interfere with the pursuit of natural history. At a rather higher elevation than the town the extensive Palace grounds contain abundant streams and woods, intersected by broad, sunny drives. The trees are rather small, permitting the pene-

tration of plenty of light, and thus favouring a luxuriant and varied undergrowth. Outside the town in another direction is open heath-clad country, traversed by streams bordered with thickets and small trees. Behind La Granja rises the fine mountain of La Peñalara with an altitude of 7976 ft. The first part of the ascent is made through pine woods and upland lawns, the last part over bare slopes with a scanty vegetation. Some hundreds of feet below the summit a few masses of snow still resist the heat of July, aided by the shade of a ravine and the artificial protection of litter.

It will be realized from the above description that La Granja is a remarkably favourable locality for the naturalist. I have never seen so much insect life or such evidence of injury from the attacks of enemies. Corresponding with these indications—the symmetrically torn and notched wings of freshly-emerged butterflies—I noticed that the birds were abundant and of many species. The numbers of birds and the prevalence of injured specimens were both especially characteristic of the Palace grounds.

The specimens from La Granja were taken at a height of about 4000 ft. The elevation of the Palace is given at 3907 ft., and the grounds rise with the slope of the Sierra to a considerably higher level. The captures outside the town were made, in some cases, at a rather lower level, in others as high or higher than the Palace. An approximate elevation of "about 4000 ft." is recorded for the insects taken upon all dates except August 25, when an excursion was made to near the summit of Peñalara. Captures were made at all the levels, including the top of a castellated mass of rock at a probable height of about 7700 ft. Insects were collected during the visit to La Granja from the 20th to the 26th of July, both dates inclusive.

In concluding a brief account of this visit to La Granja, I desire to express my obligations to Monsieur Chretien for his great kindness in inviting me to reap the fruits of his much longer and more intimate experience of this delightful locality.

July 27.—An early start was made for Segovia, where several hours were spent. A little collecting was done on the outskirts, and a considerable amount in a paved courtyard outside the cathedral. The wild flowers growing at the boundaries of the enclosure, and between the paving-

stones, as well as on a piece of waste ground at one side, attracted many insects, of which a fairly representative collection was made. The elevation is given at 3280 ft.

July 28.—El Escorial. In the morning ants were collected in one of the main streets, and in the afternoon a number of insects were captured by a little stream just above the town, and on the slope of the Sierra. Insects were abundant and varied, and considering the short space of time which was available, a fair number of species were taken. The altitude was about 2900 to 3000 ft. Although rich in insect life the Sierra Guadarrama at El Escorial is not nearly so varied or so attractive as at La Granja. The great expanse of open mountain side was well clothed with plants of many species, but the woods and groves and abundant streams were wanting.

July 30.—On the return journey one or two insects were taken at Burgos (about 3000 ft.).

In conclusion I desire to thank Colonel Yerbury for his kindness in naming the *Asilidæ* which were found attacking the Aculeates.

E. B. POULTON.

All captures in the years 1900 *and* 1902 *were made by E. B. Poulton, and no initials are affixed to these specimens. The captors in* 1901 *are indicated as in the Majorcan list, by their initials, E. B. P., W. H., and A. H.*

CAMPONOTUS MACULATUS, F.

1900. Barcelona, Vallvidrera, under stone: *Mar.* 20.—4 ☿.

1901. Port Bou: *June* 24.—1 ☿ W. H.
Montserrat, near Terminus: *July* 14.—1 ♂, 14 ☿ E. B. P.
Monistrol: *July* 16.—1 ♂ E. B. P.

CAMPONOTUS MACULATUS, race COGNATUS.

1901. Port Bou: *June* 24.—1 ☿ E. B. P.

CAMPONOTUS CRUENTATUS, Ltr.

1900. Barcelona, Vallvidrera, under stone: *Mar.* 20. —4 ☿.

1901. Montserrat, near Terminus: *July* 13.—1 ☿ E. B. P. *July* 14.—7 ☿ E. B. P., 16 ☿ A. H.

1902. La Granja, Palace Grounds: *July* 22.—1 ♂. El Escorial: *July* 28.—2 ♂, 4 ☿, 8 ♀ (one being devoured by *Dasypogon diadema* ♀, the other by *Machimus chrysitis* ♀).

CAMPONOTUS FORELI, Emery.

1901. Monistrol: *July* 16.—1 ☿ E. B. P.
1902. La Granja, Peñalara (about 7000 ft.): *July* 25.—12 ☿ on small composite flower.

CAMPONOTUS LATERALIS, Oliv.

1901. Port Bou: *June* 24.—4 ☿ W. H. Montserrat, near Terminus: *July* 14.—6 ☿ E. B. P. Hospederia to San Geronimo (3000–4000 ft.): *July* 15.—3 ☿ E. B. P. Near summit, San Geronimo (about 4000 ft.): *July* 15.—2 ☿ E. B. P.

MYRMECOCYSTUS ALBICANS, Roger (?).

1902. La Granja: *July* 24.—1 ♂. La Granja, Peñalara, near top (about 7700 ft.): *July* 25.—1 ♀ (being devoured by *Dysmachus trigonus* ♂).

FORMICA RUFA, L.

1902. La Granja, Palace Grounds: *July* 22.—2 ☿. *July* 24.—1 ♀ of race *pratensis* (being devoured by *Dasypogon diadema* ♀). La Granja, path to Peñalara (about 5500 ft.): *July* 25.—1 ♀.

FORMICA FUSCA, L.

1901. Port Bou: *June* 24.—3 ☿ W. H. Montserrat, near Terminus: *July* 14.—1 ☿ E. B. P.

FORMICA FUSCA, race CUNICULARIA.

1901. Port Bou: *June* 24.—2 ☿ A. H.

FORMICA FUSCA, race CINEREO RUFIBARBIS.

1901. Barcelona: *June* 25.—2 ☿ A. H. *July* 13.—1 ☿ A. H.
1902. La Granja: *July* 20.—11 ☿.

Lasius niger, L.

1902. Madrid: *July* 17.—1 ♂, 4 ☿.
La Granja: *July* 23.—6 ☿.
Segovia (3280 ft.): *July* 27.—3 ☿.
El Escorial: *July* 28.—51 ♂, 13 ♀, 9 ☿, one pair *in copulâ*.

Lasius niger, race emarginatus (?).

1901. Port Bou: *June* 24.—7 ☿ A. H.

Tapinoma erraticum, Ltr.

1902. La Granja: *July* 23.—1 ☿.

Tetramorium cæspitum, L.

1900. Barcelona, Vallvidrera: *Mar.* 20.—1 ☿.
1902. La Granja, Palace Grounds: *July* 20.—1 ♂.
El Escorial: *July* 28.—1 ♀.

Aphænogaster barbara, L.

1900. Barcelona, Vallvidrera, under stone: *Mar.* 20. —1 ☿.
1901. Port Bou: *June* 24.—14 ☿ W. H., 70 ☿ (major and minor) A. H.
1902. Segovia: *July* 27.—17 ☿.

Aphænogaster structor, Ltr.

1902. Madrid: *July* 17.—6 ☿.

Aphænogaster testaceopilosa, Luc.

1901. Barcelona: *July* 13.—1 ☿ E. B. P.

Aphænogaster striola, Roger.

1901. Montserrat, near Railway Terminus: *July* 14. —1 ☿ A. H.
Montserrat, Hospederia to San Geronimo (3000–4000 ft.): *July* 15.—1 ♀ E. B. P., 1 ♀ A. H.
Ditto (about 4000 ft.): 1 ♀ A. H.

Pheidole megacephala, F.

1901. Port Bou: *June* 24.—1 ♀ W. H., 10 ☿ A. H.
Montserrat, near Railway Terminus: *July* 13. —3 ♀ E. B. P., 1 ♀ W. H., 1 ♂, 15 ♀ A. H. (all winged forms). *July* 15.—1 pair *in copulâ*, E. B. P., 3 ☿ A. H.

Montserrat, Hospederia to San Geronimo (3000–4000 ft.): *July* 15.—1 ♂, 1 ♀ E. B. P., 1 ♀ W. H., 4 ☿ A. H.
Near summit, San Geronimo (about 4000 ft.): *July* 15.—1 ♀ A. H.

CREMASTOGASTER SCUTELLARIS, Oliv. var.

1901. Montserrat, near Railway Terminus: *July* 14. —15 ☿ E. B. P.

MYZINE 3-PUNCTATA, Rossi.

1901. Port Bou: *June* 24.—1 ♂ E. B. P., 2 ♂ A. H.

MYZINE 3-PUNCTATA, var. *nigrifrons*, Sm.

1901. Cerbère: *July* 17.—4 ♂ E. B. P., 5 ♂ W. H. 4 ♂ A. H.

TIPHIA FEMORATA, F.

1902. La Granja: *July* 23.—2 ♂ (one being devoured by *Dasypogon diadema* ♀).

SCOLIA FLAVIFRONS, F.

1901. Port Bou: *June* 24.—1 ♀ W. H.
Barcelona: *June* 25.—7 ♂ E. B. P., 1 ♂ A. H.

SCOLIA INTERSTINCTA, Kl.

1901. Cerbère: *July* 17.—1 ♂ A. H.
Montserrat, near Railway Terminus: *July* 15. —1 ♂ A. H.
Montserrat, Hospederia to San Geronimo (3000–4000 ft.): *July* 15.—1 ♂, 3 ♀ E. B. P., 1 ♀ A. H.

SCOLIA 4-PUNCTATA, F. Common.

Captured (1901) at Cerbère, Port Bou, Barcelona, Montserrat, and (1902) La Granja and Segovia.

SCOLIA HIRTA, Schrk.

1901. Port Bou: *June* 24.—3 ♂ A. H. (one a var. with single abdominal band).
Montserrat, Hospederia to San Geronimo (3000–4000 ft.): *July* 15.—1 ♀ E. B. P.

SCOLIA UNIFASCIATA, Cyril.

1902. La Granja: *July* 22.—4 ♂.
Segovia: *July* 27.—2 ♂.
El Escorial: *July* 28.—1 ♂.

SCOLIA (*Elis*) VILLOSA, F.

1901. Port Bou: *June* 24.—1 ♂ W. H.
Cerbère: *July* 17.—10 ♂ E. B. P., 13 ♂ W. H., 10 ♂, 1 ♀ A. H.

1902. La Granja: *July* 24.—1 ♂.
Segovia: *July* 27.—18 ♂, 1 ♀.
El Escorial: *July* 28.—1 ♂.

SCOLIA (*Elis*) 6-MACULATA, F.

1902. La Granja, Peñalara, near summit (7700 ft.): *July* 25.—1 ♂.

POMPILUS (*Pedinaspis*) AURIVILLIUSI, Tourn. (?).

1901. Montserrat, Hospederia to San Geronimo (3000–4000 ft.): *July* 15.—1 ♀ E. B. P.

POMPILUS LUCTIGERUS, Cost.

1901. Montserrat, Hospederia to San Geronimo (3000–4000 ft.): *July* 15.—1 ♂ W. H.

A well-marked ♂, easily recognizable by the tufts of hair on the 6th ventral segment.

POMPILUS VIATICUS, L.

1902. La Granja: *July* 20.—1 ♀ (being devoured by *Dasypogon diadema* ♀). *July* 22.—1 ♀.

[The striking mimetic resemblance borne by the Dipterous captor to its Aculeate prey led to the note on Asilid mimicry at the end of this memoir, p. 661. E. B. P.]

POMPILUS RUFIPES, L., var.

1901. Port Bou: *June* 24.—1 ♂ A. H.

POMPILUS FUSCIPENNIS, V. de L.

1902. La Granja: *July* 22 and 26.—2 ♀.
La Granja, path to Peñalara (about 5000 ft.): *July* 25.—1 ♀.

Fine examples of this very large species.

POMPILUS FUMIPENNIS, Lett., var. (?).

1902. La Granja, path to Peñalara (4000–7000 ft.): *July* 25.—1 ♀.

POMPILUS INDELICTUS, Tourn. (?).

1902. La Granja, above Palace: *July* 21.—1 ♀.

Pompilus 4-punctatus, F.

1902. La Granja, above Palace: *July* 21.—1 ♀.

Pseudagenia carbonaria, Scop.

1902. La Granja, Palace Grounds: *July* 20.—1 ♀.

Astata boops, Schr.

1901. Monistrol: *July* 16.—1 ♀ E. B. P.

Tachytes europæa, Kohl.

1902. La Granja: *July* 24.—1 ♂. *July* 26.—1 ♀.

Tachysphex pygidialis, Kohl.

1901. Port Bou: *June* 24.—2 ♂, 1 ♀ A. H.
Barcelona: *July* 16.—3 ♀ A. H.

Tachysphex europæa, Kohl.

1901. Port Bou: *June* 24.—1 ♂ A. H.

Tachysphex panzeri, V. de L.

1901. Barcelona: *July* 16.—2 ♀ A. H.

Trypoxylon scutatum, Chevr.

1901. Montserrat, near Railway Terminus: *July* 15.—1 ♀ A. H.

Trypoxylon figulus, L.

1902. La Granja: *July* 23.—1 ♀.

Ammophila sabulosa, L.

1901. Montserrat, near Railway Terminus: *July* 14.—1 ♂ E. B. P., 1 ♂ W. H.

Ammophila heydeni, Dhl.

1901. Cerbère: *July* 17.—1 ♂ E. B. P., 2 ♂, 1 ♀ W. H., 2 ♂, 2 ♀ A. H.
1902. El Escorial: *July* 28.—1 ♀.

Ammophila iberica, Andr.

1902. El Escorial: *July* 28.—1 ♀.

PSAMMOPHILA TYDEI, Guil.

1901. Port Bou: *June* 24.—1 ♀ E. B. P., 1 ♀ A. H.
Barcelona: *June* 25.—2 ♂ A. H. *July* 13.—1 ♀ W. H.
Montserrat, Hospederia to San Geronimo (3000–4000 ft.): *July* 15.—1 ♀ W. H.

PSAMMOPHILA HIRSUTA, Scop.

1901. Montserrat (about 3000 ft.), near Railway Terminus: *July* 14.—4 ♂ E. B. P., 1 ♂ W. H. *July* 15.—1 ♂ E. B. P.
Montserrat, Hospederia to San Geronimo (3000–4000 ft.): *July* 15.—4 ♂ E. B. P., 4 ♂ W. H., 4 ♂ A. H.

1902. La Granja, Palace Grounds: *July* 20.—1 ♂. Above Palace: *July* 21.—1 ♂. *July* 24.—1 ♂.
Peñalara, near summit (about 7500 ft.): *July* 25.—Swarm seen and several specimens captured.
El Escorial: *July* 28.—1 ♂.

[A brief account of the swarm on Peñalara, together with a suggestion as to its probable significance, is given in Proc. Ent. Soc. Lond., 1904, p. xxiv. E. B. P.]

SPHEX NUDATUS, Kohl. (?).

1902. La Granja: *July* 24.—1 ♀.

SPHEX ALBISECTUS, Lep.

1901. Port Bou: *June* 24.—1 ♂ A. H.
Barcelona: *July* 16.—1 ♀ A. H.
Montserrat, near Railway Terminus: *July* 14.—1 ♀ A. H.
Montserrat, Hospederia to San Geronimo (3000–4000 ft.): *July* 15.—1 ♀ A. H.

SPHEX SUBFUSCATUS, Dhl.

1901. Cerbère: *July* 17.—1 ♀ E. B. P.
Port Bou: *June* 24.—1 ♂ E. B. P.

1902. La Granja, above Palace: *July* 20.—1 ♂.

SPHEX FLAVIPENNIS, Ltr.

1901. Port Bou: *June* 24.—1 ♂ A. H.
Cerbère: *July* 17.—1 ♂ E. B. P.
Montserrat, near Railway Terminus: *July* 14.—1 ♂ W. H., 1 ♀ A. H.

SPHEX MAXILLOSUS, L.

1901. Montserrat, Hospederia to San Geronimo (3000–4000 ft.): *July* 15.—1 ♂ E. B. P.

SCELIPHRON FEMORATUM, F.

1901. Port Bou: *June* 24.—1 ♂ E. B. P.

SCELIPHRON PENSILIS, Ill.

1901. Cerbère: *July* 17.—1 ♂ W. H.
Port Bou: *June* 24.—1 ♀ E. B. P.
Montserrat, Hospederia to San Geronimo (3000–4000 ft.): *July* 15.—1 ♀ W. H.
1902. La Granja, Palace Grounds: *July* 20.—1 ♂.
Ditto, above Palace: *July* 21.—1 ♀.

SCELIPHRON SPIRIFEX, L.

1901. Barcelona: *July* 13.—1 ♀ E. B. P., 1 ♀ W. H.

PEMPHREDON AUSTRIACUS, Kohl. (?).

1901. Barcelona: *July* 13.—1 ♀. W. H., 2 ♂, 2 ♀ A. H.

NYSSON SCALARIS, Duf.

1902. La Granja: *July* 24.—1 ♂. *July* 26.—1 ♂, 1 ♀.

BEMBEX INTEGRA, Pz.

1902. La Granja: *July* 20.—1 ♀. *July* 25.—2 ♂. *July* 26.—1 ♂.
Ditto, above Palace: *July* 21.—1 ♀.
Ditto, Palace Grounds: *July* 22.—1 ♀.

BEMBEX SINUATA, Ltr.

1901. Cerbère: *July* 17.—1 ♂ W. H., 1 ♂ A. H.
Barcelona: *July* 13.—1 ♀ E. B. P., 1 ♂ A. H. *July* 16.—Abundant.
Montserrat, Hospederia to San Geronimo (3000–4000 ft.): *July* 15.—1 ♂ E. B. P.

BEMBEX OCULATA, Ltr. var.

1901. Barcelona: *June* 25.—1 ♂ E. B. P.

Bembex mediterranea, Hdl.

1901. Barcelona: *July* 16.—1 ♀ E. B. P.

Cerceris bupresticida, Duf.

1902. La Granja: *July* 20.—5 ♀. *July* 23.—4 ♂.
El Escorial: *July* 28.—1 ♂.

Cerceris 4-maculata, Duf.

1901. Monistrol: *July* 16.—1 ♀ E. B. P.

Cerceris emarginata, Pz.

1901. Cerbère: *July* 17.—1 ♂ E. B. P.
Port Bou: *June* 24—1 ♂ W. H.
Barcelona: *July* 13.—1 ♂ W. H., 1 ♂ A. H. *July* 16.—2 ♂ E. B. P., 1 ♂ W. H., 2 ♂, 1 ♀ A. H.
Montserrat, near Railway Terminus: *July* 14. —2 ♂ E. B. P.
Monistrol: *July* 13.—1 ♀ E. B. P. *July* 16.—1 ♂ A. H.

Ditto, var. (?).

1902. La Granja: *July* 23.—1 ♂. *July* 24.—1 ♂. *July* 26.—1 ♂.

Cerceris rybyensis, L.

1901. Montserrat, near Railway Terminus: *July* 14. —1 ♂ E. B. P., 1 ♂ A. H.
Montserrat, Hospederia to San Geronimo (3000–4000 ft.): *July* 15.—1 ♀ E. B. P., 1 ♀ A. H.
Ditto, near summit (about 4000 ft.): *July* 15. —1 ♀ A. H.

Ditto, var.

1901. Barcelona: *July* 16.—1 ♀ A. H.

Cerceris 4-cincta, V. de L.

1901. Barcelona: *July* 16.—1 ♀ A. H.
Montserrat, near Railway Terminus: *July* 14. —2 ♂ E. B. P., 1 ♂ W. H., 3 ♂, 1 ♀ A. H. *July* 15.—1 ♀ E. B. P., 1 ♀ A. H.
Montserrat, Hospederia to San Geronimo (3000–4000 ft.): *July* 15.—4 ♂ E. B. P., 1 ♂ A. H.

CERCERIS FERRERI, V. de L.

1901. Port Bou : *June* 24.—1 ♂ E. B. P.

CERCERIS LABIATA, F.

1901. Montserrat, Hospederia to San Geronimo (3000–4000 ft.): *July* 15.—1 ♂ E. B. P.

CERCERIS ARENARIA, L.

1901. Montserrat, near Railway Terminus: *July* 14. —3 ♂ E. B. P.
Montserrat, Hospederia to San Geronimo (3000–4000 ft.): *July* 15.—1 ♂ W. H.

PHILANTHUS TRIANGULUM, F.

1901. Barcelona: *June* 25.—2 ♂ E. B. P., 4 ♂ A. H. *July* 13.—3 ♂ E. B. P. *July* 16. —Abundant. Females captured as well as males, although not in equal numbers.

OXYBELUS 14-NOTATUS, Jur.

1901. Barcelona: *July* 13.—1 ♂ W. H., 1 ♂ A. H.

OXYBELUS 3-SPINOSUS, F.

1901. Barcelona: *July* 13.—1 ♂ A. H. *July* 16. —1 ♀ W. H.

OXYBELUS MELANCHOLICUS, Chevr.

1902. La Granja, above Palace: *July* 21.—1 ♀.

OXYBELUS LAMELLATUS, Oliv.

1901. Barcelona: *June* 25.—3 ♀ A. H.

ENTOMOGNATHUS BREVIS, V. de L.

1901. Montserrat, near Railway Terminus: *July* 14. —1 ♂, 1 ♀ E. B. P.

CRABRO HYPSÆ, de Stef., *punctatus*, H.-Sch. (nec Lep.?).

1901. Cerbère: *July* 17: 1 ♀ E. B. P.

CRABRO CLYPEATUS, Schreb.

1901. Cerbère: *July* 17.—1 ♀ A. H.
Barcelona: *July* 16.—1 ♀ A. H.

CELONITES ABBREVIATUS, Vill.

1901. Cerbère: *July* 17.—1 ♂ E. B. P.

VESPA GERMANICA, Fab.

1901. Barcelona: *June* 25.—1 ♀ E. B. P.
Montserrat, Hospederia to San Geronimo (3000–4000 ft.): *July* 15.—1 ♀ A. H.

VESPA SYLVESTRIS, Scop.

1902. La Granja: *July* 20.—1 ☿, 1 ♀. *July* 25.—1 ☿. Above Palace: *July* 21.—1 ☿.

POLISTES GALLICA, L. Very common.

[At Port Bou this species was seen to be devoured by *Dasypogon diadema* ♀. (Trans. Ent. Soc. Lond., 1902, p. 335.) E. B. P.]

EUMENES COARCTATA, L. Common.

RHYNCHIUM OCULATUM, F.

1901. Barcelona: *July* 16.—2 ♀ E. B. P., 1 ♂ A. H.
Monistrol: *July* 13.—1 ♀ E. B. P.

ODYNERUS OPACUS, Mor.

1901. Barcelona: *July* 16.—1 ♀ A. H.

ODYNERUS DANTICI, Rossi.

1901. Barcelona: *July* 13.—2 ♂ E. B. P., 3 ♂, 1 ♀ A. H. *July* 16.—4 ♀ E. B. P., 1 ♂, 1 ♀ W. H., 3 ♂, 5 ♀ A. H.

ODYNERUS DANTICI, var.

1901. Montserrat, Hospederia to San Geronimo (3000–4000 ft.): *July* 15.—2 ♂ E. B. P., 2 ♂ A. H.
1902. La Granja: *July* 23.—3 ♂.
El Escorial: *July* 28.—1 ♀.

ODYNERUS PARVULUS, Sauss., var. (?) ♂.

1901. Port Bou: *June* 24.—1 ♂ A. H.
1902. La Granja: *July* 23.—2 ♂.
El Escorial: *July* 28.—2 ♂.

In these specimens all the segments are bordered with yellow, and the antennæ are pale beneath.

ODYNERUS SIMPLEX, Fab.

1901. Barcelona: *June* 25.—1 ♂, 1 ♀ E. B. P. *July* 16.—1 ♀ E. B. P., 4 ♀ A. H.
1902. El Escorial: *July* 28.—1 ♀.

ODYNERUS ELEGANS, Wesm.

1901. Montserrat, near Railway Terminus: *July* 14. —1 ♀ E. B. P.

ODYNERUS SPIRICORNIS, Spin.

1902. La Granja: *July* 20.—1 ♂, 8 ♀. *July* 22.— 1 ♂, 1 ♀.

ODYNERUS PARIETUM, L.

1901. Port Bou: *June* 24.—1 ♂ A. H.
Barcelona: *July* 13.—1 ♂ E. B. P., 1 ♂ A. H. *July* 16.—2 ♂ A. H.
Montserrat, near Railway Terminus: *July* 14. —2 ♀ E. B. P.
Montserrat, Hospederia to San Geronimo (3000–4000 ft.): *July* 15.—3 ♂ A. H.
Montserrat, near summit, San Geronimo (about 4000 ft.): *July* 15.—1 ♂ E. B. P.

ODYNERUS ALPESTRIS, Sauss.

1901. Montserrat, Hospederia to San Geronimo (3000–4000 ft.): *July* 15.—1 ♀ A. H.

PROSOPIS VARIEGATA, F.

1901. Cerbère: *July* 17.—1 ♂ E. B. P.
Monistrol: *July* 16.—1 ♀ A. H. Var. with white central line on clypeus.
1902. La Granja: *July* 24.—1 ♀. Var. with clypeus spotted. *July* 26.—1 ♂.

PROSOPIS PICTUS, Smith.

1901. Barcelona: *July* 13.—1 ♀ E. B. P., 3 ♂ W. H., 2 ♂ A. H. *July* 16.—1 ♀ A. H.

PROSOPIS COMMUNIS, Nyl.

1902. La Granja, Palace Grounds: *July* 20.—1 ♀.

PROSOPIS SULPHURIPES, Grib.

1901. Montserrat, near Railway Terminus: *July* 14. —1 ♂ E. B. P. *July* 15.—1 ♀ A. H.
Montserrat, Hospederia to San Geronimo (3000–4000 ft.): *July* 15.—1 ♀ E. B. P.

PROSOPIS HYALINATUS, Sm.

1901. Montserrat, near Railway Terminus: *July* 14. —1 ♂, 1 ♀ A. H.
Montserrat, Hospederia to San Geronimo (3000–4000 ft.): *July* 15.—2 ♀ E. B. P.
1902. La Granja: *July* 23.—1 ♂, 1 ♀.
Segovia: *July* 27.—1 ♂.

PROSOPIS, sp. near GENALIS, Thoms., n. sp. (?).

1901. Montserrat, near Railway Terminus: *July* 14. —1 ♀ E. B. P.

PROSOPIS CLYPEARIS, Schk.

1901. Montserrat, near Railway Terminus: *July* 14. —1 ♀ E. B. P., 2 ♂ A. H.
Montserrat, Hospederia to San Geronimo (3000–4000 ft.): *July* 15.—2 ♀ E. B. P.

PROSOPIS PICTIPES, Nyl.

1901. Port Bou: *June* 24.—1 ♂ A. H.
1902. La Granja: *July* 23.—1 ♂.

PROSOPIS BISINUATUS, Forst., *angustatus*, Schk., var. (?).

1901. Barcelona: *June* 25.—1 ♂ A. H. *July* 13. 1 ♂ W. H., 5 ♂ A. H.

Differs from *angustatus* in the thinner antennal scape, and is apparently quite distinct, but a similar difference occurs between *brevicornis* and *imparilis*, which makes one doubt if in both cases there may not be two distinct varietal forms.

PROSOPIS IMPARILIS, Forst., *brevicornis*, var. (?).

1901. Cerbère: *July* 17.—1 ♂ E. B. P., 1 ♂ A. H.

COLLETES LIGATUS, Er.

1901. Port Bou: *June* 24.—1 ♀ W. H., 1 ♂ A. H.
Montserrat, Hospederia to San Geronimo (3000–4000 ft.): *July* 15.—1 ♂ E. B. P.
Montserrat, near summit, San Geronimo (about 4000 ft.): *July* 15.—1 ♀ W. H.

COLLETES, sp. (?). Small, short genæ, very finely-punctured 2nd abdominal segment.

1902. La Granja: *July* 23.—4 ♀. *July* 24.—2 ♀.

The species of this genus are at present in such a confused state that it is useless to describe any as new from females only; the males have been carefully worked, for such species as were known to him, by the Rev. F. D. Morice (Trans. Ent. Soc., 1904, pt. I), but their respective females are in many cases quite unrecognized, and until the many described males can be associated with suitable females it would only be complicating synonymy to give new names to members of the latter sex.

COLLETES PICISTIGMA, Thoms.

1901. Montserrat, Hospederia to San Geronimo (3000–4000 ft.): *July* 15.—1 ♂ A. H.

Ditto, sp. (?). Large, short genæ, near *picistigma* (?).

1902. La Granja: *July* 24.—1 ♀.

COLLETES FODIENS, Kirb.

1902. La Granja: *July* 23.—1 ♂. *July* 24.—1 ♀. *July* 26.—2 ♀.

COLLETES ABEILLEI, Per. MS.

1901. Montserrat, Hospederia to San Geronimo (3000–4000 ft.): *July* 15.—2 ♂, 1 ♀ E. B. P.
Montserrat, near summit, San Geronimo (about 4000 ft.): *July* 15.—1 ♂ W. H.

SPHECODES FUSCIPENNIS, Germ.

1901. Barcelona: *June* 25.—1 ♀ A. H.
Montserrat, near summit, San Geronimo (about 4000 ft.): *July* 15.—2 ♂ E. B. P., 1 ♂ A. H.

SPHECODES GIBBUS, L.

1901. Montserrat, near summit, San Geronimo (about 4000 ft.): *July* 15.—6 ♂, 1 ♀ E. B. P., 2 ♂ W. H., 3 ♂ A. H.

1902. La Granja: *July* 26.—1 ♂ (being devoured by *Dasypogon diadema* ♀).

SPHECODES SUBQUADRATUS, Sm.

1901. Montserrat, near Railway Terminus: *July* 15. —1 ♂ E. B. P., 1 ♀ A. H.

Montserrat, near summit, San Geronimo (about 4000 ft.): *July* 15.—9 ♂ E. B. P., 3 ♂ W. H., 6 ♂ A. H.

SPHECODES RETICULATUS, Thoms.

1901. Montserrat, near summit, San Geronimo (about 4000 ft.): *July* 15.—16 ♂, 2 ♀ E. B. P., 22 ♂, 1 ♀ (one of the males being eaten by spider on yellow umbelliferous flower-head), W. H., 14 ♂ A. H.

Montserrat, near Railway Terminus: *July* 15. —1 ♂ A. H.

SPHECODES RUFIVENTRIS, Pz.

1901. Montserrat, near Railway Terminus: *July* 15. —1 ♂ A. H.

Montserrat, near summit, San Geronimo (about 4000 ft): *July* 15.—2 ♂ E. B. P., 1 ♂ W. H.

Ditto, sp. (?).

1901. Montserrat, near Railway Terminus: *July* 15. —1 ♀ A. H.

[The five first-named species of *Sphecodes* are indistinguishable in the field. They fly together, and were all found visiting the flowers in the open grassy valley just below San Geronimo, close to the summit of Montserrat, on July 15, 1901. It will be seen that *S. fuscipennis* and *S. rufiventris* were much less common than the others. The abundance of these Aculeates, as well as their intimate association with one another and with their mimics, is well shown in the following experience. I observed resting on a flower in the valley a black fly with red abdomen, beautifully mimetic of these Hymenoptera. Mr. E. E. Austen kindly informs me that the species is the Tachinid, *Ocyptera brevicornis*, Lw. It occurred to me that by a single strong sweep of the net I should probably secure not only the mimic but a number of its models as well. The twenty-one insects thus captured were carefully labelled and kept distinct from others. With the exception of the fly all are Aculeates, and they are of course

included in the numbers given in the present memoir. Separated out from other captures of the same species the list is as follows:—

Sphecodes fuscipennis . . .	1 ♂
" *gibbus*	3 ♂
" *subquadratus* . .	7 ♂
" *reticulatus* . . .	7 ♂
" *rufiventris* . . .	1 ♂
The mimetic fly—	
Ocyptera brevicornis . . .	1
	20

The twenty-first insect was the only specimen of *Epeolus productus* (♀) in the material described in this paper.

The whole of the captures made by the three naturalists on that sunny afternoon by San Geronimo afford the material for a much larger group, including far greater numbers of the same species of *Sphecodes* and some additional species of Aculeates with the same general appearance. This complete group is shown below. In the right-hand column will be found a record of all other captures of the constituent species in Spain during the same expedition (1901).

A glance at the table on p. 646 suggests the following conclusions:—

(1) *Sphecodes reticulatus* was the dominant species on July 15, while three out of the five species of *Sphecodes* were far more abundant than any other members of the entire group.

(2) There was an evident special association of the species of the group in the locality at San Geronimo. A large proportion of them were not taken elsewhere.

(3) The elevation had obviously delayed the emergence of the species of *Sphecodes*, so that hardly any females had as yet appeared. The proportion of the sexes only 1000 feet lower was very different.

Mr. Edward Saunders tells me that "with few exceptions the males of *Sphecodes* precede the females by a week or so. In the autumn when both are out the females are found more round the burrows and not so much on the flowers as in the spring. The new females hibernate and the males die off."

(4) It is probable that the stingless males of Aculeates

	Group captured below San Geronimo, near summit of Montserrat (about 4000 feet), July 15, 1901.	Other examples of same species captured elsewhere in Spain, June—July, 1901.
Synaposematic species of *Sphecodes*.	*Sphecodes fuscipennis.* 3 ♂.	1 ♀, Barcelona, June 25.
	,, *gibbus.* 11 ♂, 1 ♀.	
	,, *subquadratus.* 18 ♂.	1 ♂, 1 ♀, Montserrat, ab. 3000 ft., July 15.
	,, *reticulatus.* 52 ♂, 3 ♀.	1 ♂, Montserrat, about 3000 feet, July 15.
	,, *rufiventris.* 3 ♂.	1 ♂, Montserrat, about 3000 feet, July 15.
	,, sp.?	1 ♀, Montserrat, about 3000 feet, July 15.
Other Aculeates synaposematic with *Sphecodes* group.	*Halictus interruptus.* 1 ♂. Male only convergent to *Sphecodes*.	1 ♀, Montserrat, about 3000 feet, July 14. 7 ♀, Port Bou, June 24.
	Halictus elegans. 1 ♀.	1 ♂, Montserrat, about 3000 feet, July 14.
	Nomada eos. 2 ♀.	
	Osmia fallax. 1 ♂.	
Other Orders of insects mimetic of *Sphecodes*.	DIPTERA. *Ocyptera brevicornis.* 1.	

possess some special defence, perhaps by means of a secretion, or the juices of the body. It is difficult otherwise to account for the dominant central species of mimetic groups being composed even temporarily of males, to the almost complete exclusion of females. It must be remembered that tropical *Braconidæ* are freely mimicked (P. Z. S., 1902, p. 230), and that an experiment of Mr. Guy A. K. Marshall's indicates that the latter are defended in

the manner suggested above (Trans. Ent. Soc. 1902, pp. 386, 387).

I cannot doubt that a closer attention to the facts of mimicry in the Aculeates would long ago have revealed the insufficiency of the Batesian hypothesis and the necessity of that to which Fritz Müller was driven in 1870. The group on Montserrat may be compared in the closest manner with the synaposematic Neotropical Rhopalocera. The central species, belonging to the genus *Sphecodes*, represent the *Ithomiinæ*, usually the dominant members of the South American groups. The genera *Halictus*, *Nomada*, and *Osmia*, similarly represent the convergent *Lycorea*, *Heliconius*, and *Actinote*; while the fly *Ocyptera* may be to some extent paralleled by a Heterocerous mimic, such as *Pericopis* or *Castnia*.

As regards both groups we may feel the same confidence that the Müllerian explanation of common warning colours accounts for nearly the whole of the facts: as regards both the same uncertainty as to whether some outlying member, such as the fly in one or *Castnia* in the other, may not be a real (Pseudaposematic) mimic in the Batesian sense. In both groups the fact lost sight of by Bates is equally evident, viz. that the mimicry is closest between those members whose special defence is clearest—that just as the mimicry of Ithomiine by Heliconine far transcends the resemblance borne to the former by Danaine, Nymphaline, Pierine, or moth, so the likeness of other Aculeate genera for *Sphecodes* far surpasses that borne by the mimetic Dipteron. In fact, Mr. Saunders speaks of the similarity between the females of some of the small southern species of *Halictus* and *Sphecodes* being so great that he has often to look for structural characters at the apex of the abdomen in order to decide upon the genus. In speaking of this remarkable resemblance the great Hymenopterist, indeed, suggests the probability that *Halictus* and *Sphecodes* arose from a single stock at no distant date. But, however recent this period may be, it is highly improbable that superficial likeness in colour and pattern can be its heritage, inasmuch as a safe distinction can be established by an appeal to comparatively deep-seated structural characters.

This interesting group is only a section of a very large assemblage of Aculeates characterized by a black ground-colour, and the development of more or less red on the abdominal segments. Mr. Saunders has kindly

given me the constitution, in a general way, of this assemblage in the Palæarctic Region. It is as follows:—

Fossores.

Mutilla: only a few males in an extensive genus.

Scolia: ♀ of one species in a genus of about 20 species.

Sapyga: ♀ of one or two species out of 8 or 10.

Myzine: ♀ of one or two species out of 20 or 30.

Pompilus: both sexes of over 200 described species (probably many are synonymous). More than half the genus.

Salius: many species, but less than half the genus.

Ceropales: one species out of about 5.

Pseudagenia: one species out of 4 or 5.

Astatus: nearly all the species of a small genus.

Tachytes and *Tachysphex*: more than half the species in each of these extensive genera.

Larra: one species only.

Gorytes: a small section only of a genus mostly composed of black and yellow wasp-like species.

Entomosericus: both species.

Mimesa: not far from half of about 15 species.

Sphex: many species of an extensive genus.

Ammophila: many species of an extensive genus.

Alyson (small genus): 2 or 3 species.

Nysson (medium-sized genus): a few species.

Didineis: both species.

Dinetus: 1 species only in genus.

Miscophus: 3 species out of about 10.

Anthophila.

Prosopis: about 5 species out of 60 or 70.

Halictus: 8 or 10 out of 100 or more.

Sphecodes *: some 20 species or so. Practically the whole genus.

Andrena: about 20 species out of 200 or more.

Nomada *: nearly half a large genus.

Osmia: a very few out of about 200.

Dioxys *: most of the species (about 6 or 8).

Phiarus,* *Pasites*,* *Biastes*,* *Ammobates* *: nearly all the species in these small genera.

The absence of species belonging to the formidable Diploptera is remarkable. A brick-red colour is known on the *basal* segment of the abdomen in several species

* Genera thus marked are known or suspected to be inquiline.

from the Canaries and Madeira, and yellowish-red also in a few European species. It is, however, very little developed, and the effect is quite different from the broad transverse band of the abdomen in *Pompilus*, etc.

This great assemblage of species convergent in colours and pattern can be broken up into many sub-groups, more or less closely welded together by intermediate links. Thus the dark wings and intense black of the species of *Pompilus*, together with the position of their deep red abdominal bands, make a very characteristic sub-group. The black and red species of *Ammophila* form the centre of another, while perhaps the most extensive of all these subordinate associations is that which has *Sphecodes* for its centre—the group of which we had so interesting an experience in the valley below San Geronimo. E. B. P.]

HALICTUS 4-CINCTUS, F.

1901. Port Bou: *June* 24.—1 ♀ A. H.
Barcelona: *July* 16.—1 ♂, 3 ♀ W. H., 1 ♀ A. H.
Montserrat, near summit, San Geronimo (about 4000 ft.): *July* 15.—3 ♂ E. B. P., 4 ♂ W. H., 5 ♂ A. H.

HALICTUS 6-CINCTUS, F.

1901. Barcelona: *July* 16.—1 ♀ W. H.

HALICTUS SCABIOSÆ, Rossi. Common, var. (?) *ochraceovittatatus*, Drs.

HALICTUS TETRAZONIUS, Klug.

1901. Port Bou: *June* 24.—1 ♂, 1 ♀ W. H.

HALICTUS PYRENÆUS, Per. (?).

1901. Montserrat, near Railway Terminus: *July* 14. —4 ♀ E. B. P., 3 ♀ W. H., 2 ♀ A. H. *July* 16.—2 ♀ W. H.
Montserrat, Hospederia to San Geronimo (3000–4000 ft.): *July* 15.—1 ♀ W. H.
Montserrat, near summit, San Geronimo (about 4000 ft.): *July* 15.—1 ♀ E. B. P., 2 ♀ W. H.
1902. El Escorial: *July* 28.—1 ♀.

HALICTUS, sp. (?).

1901. Montserrat, near Railway Terminus: *July* 14. —2 ♂ A. H.

Allied to *tetrazonius*, but with the mandibles simple; differs from Perez's description of *pyrenæus* in the short cheeks, and the want of the pencils of hairs at the lateral apices of the 4th ventral segment.

HALICTUS SEPARANDUS, Schmied.

1901. Port Bou: *June* 24.—1 ♀ A. H.
Cerbère: *July* 17.—1 ♂ E. B. P.
Montserrat, near Railway Terminus: *July* 14. —3 ♂ E. B. P., 1 ♂, 1 ♀ A. H. *July* 16. —1 ♂ W. H.
Montserrat, near summit, San Geronimo (about 4000 ft.): *July* 15.—1 ♂ W. H.

HALICTUS PLATYCESTUS, Dours.

1901. Barcelona: *July* 16.—2 ♀ E. B. P., 5 ♀ W. H., 1 ♀ A. H.

HALICTUS LEUCOZONIUS, Kirb.

1901. Montserrat, Hospederia to San Geronimo (3000–4000 ft.): *July* 15.—1 ♂ W. H.
Montserrat, near Railway Terminus: *July* 16. —1 ♀ W. H.

HALICTUS INTERRUPTUS, Pz.

1901. Port Bou: *June* 24.—2 ♀ E. B. P., 2 ♀ W. H., 3 ♀ A. H.
Montserrat, near Railway Terminus: *July* 14. —1 ♀ E. B. P.
Montserrat, near summit, San Geronimo (about 4000 ft.): *July* 15.—1 ♂ W. H.

HALICTUS, sp. (?).

1901. Port Bou: *June* 24.—1 ♀ A. H.

HALICTUS COSTULATUS, K.

1902. La Granja: *July* 22.—1 ♀. *July* 23.—2 ♀. *July* 24.—2 ♀. *July* 26.—1 ♀. *July* 26. —1 ♂ (being devoured by *Dasypogon diadema* ♀).
La Granja, above Palace: *July* 21.—1 ♀.

Halictus elegans, Lep.

1901. Montserrat, near Railway Terminus: *July* 14. —1 ♂ A. H.
Montserrat, near summit, San Geronimo (about 4000 ft.): *July* 15.—1 ♀ A. H.

This is considered by many authors to be a variety of *cylindricus*, but its elongate face appears to me to separate it easily in both sexes from that species.

Halictus cylindricus, Fab.

1902. La Granja, Palace Grounds: *July* 20.—1 ♀.

Halictus malachurus.

1902. La Granja: *July* 23.—1 ♀ (being devoured by *Dasypogon diadema* ♀).

Halictus brevicornis, Schk.

1901. Montserrat, near Railway Terminus: *July* 15. —1 ♂ E. B. P.
Montserrat, Hospederia to San Geronimo (3000–4000 ft.): *July* 15.—1 ♀ E. B. P., 1 ♀ W. H., 1 ♀ A. H.
Montserrat, near summit, San Geronimo (about 4000 ft.): *July* 15.—1 ♀ A. H.

Halictus minutissimus, K.

1901. Montserrat, near Railway Terminus: *July* 15. —1 ♀ E. B. P.

Halictus punctatissimus, Schenck.

1901. Montserrat, near Railway Terminus: *July* 14. —1 ♀ E. B. P.

Halictus dubitabilis, E. Saund.

1901. Montserrat, near Railway Terminus: *July* 14. —1 ♂ E. B. P.

Halictus mucoreus, Gv.

1901. Port Bou: *June* 24.—1 ♀ W. H., 1 ♀ A. H.
Barcelona: *July* 16.—1 ♂ E. B. P.
Monistrol: *July* 16.—1 ♀ A. H.

Halictus gramineus, Sm.

1901. Cerbère: *July* 17.—1 ♀ E. B. P., 3 ♀ W. H., 1 ♀ A. H.
Port Bou: *June* 24.—2 ♀ W. H., 4 ♀ A. H.
Montserrat, near Railway Terminus: *July* 14. —7 ♀ E. B. P., 1 ♀ W. H., 3 ♀ A. H. *July* 15.—1 ♀ E. B. P.
Montserrat, Hospederia to San Geronimo (3000–4000 ft.): *July* 15.—4 ♀ E. B. P., 3 ♀ W. H.

Halictus gemmeus, Drs.

1901. Cerbère: *July* 17.—8 ♀ E. B. P., 7 ♀, 1 ♂ A. H.
Port Bou: *June* 24.—1 ♀ W. H.
Barcelona: *July* 13.—1 ♀ A. H.
Montserrat, near Railway Terminus: *July* 14. —1 ♀ A. H.
Montserrat, Hospederia to San Geronimo (3000–4000 ft.): *July* 15.—1 ♀ W. H.

Halictus morio, Fab.

1901. Montserrat, near Railway Terminus: *July* 14. —1 ♂, 1 ♀ E. B. P.

Halictus leucopus, Kirb.

1901. Montserrat, near Railway Terminus: *July* 14. —1 ♂, 1 ♀ E. B. P.

Halictus smeathmanellus, Kirb.

1901. Montserrat, near Railway Terminus: *July* 14. —1 ♀ A. H. *July* 15.—1 ♀ A. H.

Andrena pilipes, Fab.

1901. Barcelona: *July* 16.—1 ♀ W. H.

Andrena fulvicrus, Kirb.

1901. Montserrat, Hospederia to San Geronimo (3000–4000 ft.): *July* 15.—1 ♂ A. H.

Andrena distincta, Luc.

1901. Montserrat, Hospederia to San Geronimo (3000–4000 ft.): *July* 15.—1 ♀ E. B. P.

This agrees exactly with a specimen I have in my collection named some years ago by Prof. Perez.

ANDRENA, sp. (?), *dorsata* group.

1902. La Granja, above Palace: *July* 21.—1 ♀.

ANDRENA ALBOFASCIATA, Thoms.

1902. La Granja: *July* 23.—1 ♀.

NOMADA EOS, Schm.

1901. Montserrat, near summit, San Geronimo (about 4000 ft.): *July* 15.—2 ♀ A. H.

EPEOLUS PRODUCTUS, Thoms.

1901. Montserrat, near summit, San Geronimo (about 4000 ft.): *July* 15.—1 ♀ E. B. P.

CERATINA CUCURBITINA, Rossi.

1901. Cerbère: *July* 17.—5 ♀ E. B. P., 5 ♀ W. H., 8 ♀ A. H.
Barcelona: *July* 16.—1 ♀ W. H.
Montserrat, near Railway Terminus: *July* 14.—1 ♀ W. H., 1 ♀ A. H. *July* 15.—1 ♀ A. H.

CERATINA ACUTA, Friese.

1901. Cerbère: *July* 17.—1 ♀ E. B. P., 2 ♀ A. H.

CERATINA CYANEA, K.

1901. Cerbère: *July* 17.—1 ♂, 1 ♀ E. B. P., 4 ♂ A. H.

CERATINA CYANEA, K. (?).

1901. Monistrol: *July* 16.—1 ♂ A. H.

This specimen agrees, so far as I can see, essentially with *cyanea*, K., but it has the tubercles white.

CERATINA CALLOSA, F.

1901. Barcelona: *July* 16.—1 ♀ A. H.

CERATINA CHALCITES, Germ.

1901. Montserrat, near Railway Terminus: *July* 14.—2 ♀ A. H.

1902. La Granja: *July* 26.—1 ♀.

CERATINA DALLATORREANA, Friese.

1901. Cerbère: *July* 17.—1 ♀ E. B. P.

Xylocopa violacea, L.

1901. Port Bou: *June* 24.—1 ♀ A. H.

Xylocopa cantabrica, Lep.

1902. La Granja: *July* 20.—2 ♀. *July* 25.—1 ♀.

Xylocopa valga, Gerst.

1902. La Granja: *July* 20.—1 ♂. *July* 24.—1 ♂. *July* 25.—1 ♀

Cœlioxys aurolimbata, Foerst.

1901. Barcelona: *June* 25.—1 ♂ E. B. P. *July* 16.—2 ♀ E. B. P.

Cœlioxys afra, Lep.

1901. Montserrat, Hospederia to San Geronimo (3000–4000 ft.): *July* 15.—1 ♂ A. H.

Cœlioxys conoidea, Ill.

1902. La Granja: *July* 25.—1 ♀.

Megachile lagopoda, L.

1901. Barcelona: *June* 25.—1 ♂ A. H. *July* 16.—1 ♂, 1 ♀ E. B. P., 1 ♀ A. H.
1902. La Granja: *July* 25.—1 ♂.
La Granja (on thistle): *July* 26.—3 ♀.

Megachile willughbiella, Kirb.

1902. La Granja: *July* 25.—1 ♀.

Megachile pilicrus, Mor.

1902. La Granja: *July* 25.—1 ♂.
El Escorial: *July* 28.—1 ♀.

Megachile melanopyga, Cost.

1901. Barcelona: *July* 16.—1 ♂ W. H.

Megachile sericans, Duf.

1901. Cerbère: *July* 17.—1 ♂, 4 ♀ W. H.

MEGACHILE ERICETORUM, Lep.

1901. Barcelona: *June* 25.—2 ♂ E. B. P., 3 ♂ A. H. *July* 13.—1 ♂ E. B. P. *July* 16.—1 ♂ E. B. P., 1 ♂ W. H., 4 ♂ A. H.
1902. La Granja: *July* 23.—1 ♂. *July* 25.—2 ♂, 1 ♀. Segovia: *July* 27.—1 ♂.

MEGACHILE CENTUNCULARIS, L.

1901. Barcelona: *June* 25.—1 ♂ A. H. *July* 13.—1 ♂ E. B. P., 1 ♂ W. H. *July* 16.—1 ♂, 1 ♀ E. B. P., 1 ♂, 1 ♀ A. H.

MEGACHILE ARGENTATA, F.

1901. Port Bou: *June* 24.—2 ♂ A. H.
Barcelona: *June* 25.—1 ♀ E. B. P. *July* 13.—2 ♂, 2 ♀ E. B. P., 2 ♂ A. H. *July* 16.—2 ♂ E. B. P.
Montserrat, near Railway Terminus: *July* 14.—1 ♀ E. B. P., 2 ♂ A. H. *July* 15.—1 ♀ E. B. P. *July* 16.—1 ♂ W. H.
Montserrat, Hospederia to San Geronimo (3000–4000 ft.): *July* 15.—1 ♂ A. H.
1902. La Granja: *July* 24.—1 ♀.
Segovia: *July* 27.—4 ♂.

MEGACHILE DORSALIS, Per.

1901. Barcelona: *July* 13.—1 ♂ A. H.

MEGACHILE, sp. (?).

1901. Port Bou: *June* 24.—1 ♂ E. B. P.

MEGACHILE APICALIS, Spin.

1901. Cerbère: *July* 17.—1 ♂, 2 ♀ W. H., 2 ♀ A. H.
Barcelona: *July* 13.—1 ♂ A. H. *July* 16.—1 ♀ E. B. P., 1 ♂, 1 ♀ A. H.
1902. Segovia: *July* 27.—5 ♂.

LITHURGUS CHRYSURUS, Fonsc.

1901. Barcelona: *July* 16.—1 ♀ E. B. P., 1 ♀ A. H.
1902. Segovia: *July* 27.—2 ♂.

Anthidium manicatum, L.

1901.—Cerbère: *July* 17.—1 ♀ W. H.
Barcelona: *June* 25.—1 ♂ E. B. P., 2 ♂, 7 ♀ A. H. *July* 16.—1 ♀ W. H., 1 ♂ A. H.
1902. La Granja: *July* 25.—1 ♂.

Anthidium cingulatum, Ltr.

1901. Barcelona: *July* 16.—1 ♀ W. H.
1902. La Granja: *July* 25.—1 ♀.
El Escorial: *July* 28.—1 ♀.

Anthidium florentinum, F.

1901. Port Bou: *June* 24.—1 ♂, 2 ♀ W. H.
Barcelona: *June* 25.—1 ♂ E. B. P., 1 ♂ A. H. *July* 13.—2 ♀ E. B. P., 1 ♂ W. H. *July* 16.—1 ♂, 1 ♀ E. B. P., 1 ♀ W. H., 1 ♂, 1 ♀ A. H.

Anthidium 7-dentatum, Ltr.

1901. Montserrat, near Railway Terminus: *July* 14.—1 ♂ E. B. P., 1 ♀ W. H. *July* 15.—1 ♂ E. B. P.
Montserrat, near summit, San Geronimo (about 4000 ft.): *July* 15.—1 ♀ W. H.

Anthidium latreillei, Lep.

1901. Cerbère: *July* 17.—2 ♀ E. B. P., 2 ♂, 1 ♀ W. H., 2 ♂, 2 ♀ A. H.
Port Bou: *June* 25.—1 ♀ A. H.

Anthidium oblongatum, Ltr.

1901. Montserrat, near Railway Terminus: *July* 14.—2 ♀ E. B. P. *July* 15.—1 ♂ A. H.
Montserrat, near summit, San Geronimo (about 4000 ft.): *July* 15.—1 ♂, 3 ♀ E. B. P., 2 ♂ W. H., 2 ♂ A. H.
1902. La Granja: *July* 22.—1 ♂.
Segovia: *July* 27.—1 ♀.

Anthidium strigatum, Pz.

1901. Cerbère: *July* 17.—1 ♂ E. B. P., 1 ♂ A. H.
Barcelona: *July* 13.—1 ♀ E. B. P.
Montserrat, near Railway Terminus: *July* 14.—1 ♂ A. H.

ANTHIDIUM BELLICOSUM, Lep.

1901. Montserrat, near Railway Terminus: *July* 14. —1 ♀ W. H.

STELIS ATERRIMA, Panz.

1901. Montserrat, near Railway Terminus: *July* 14. —1 ♂ E. B. P., 2 ♂ A. H.
1902. El Escorial: *July* 28.—1 ♀.

STELIS BREVIUSCULA, Nyl.

1902. Segovia: *July* 27.—4 ♀.

ERIADES TRUNCORUM, L.

1902. La Granja: *July* 23.—2 ♂.
Segovia: *July* 27.—6 ♂.

ERIADES CRENULATA, Nyl.

1901. Barcelona: *July* 16.—1 ♀ W. H.
Montserrat, near Railway Terminus: *July* 14. —1 ♀ A. H.
1902. Segovia: *July* 27.—15 ♂.

The Montserrat female (July 14, 1901) has no proper ventral brush.

OSMIA FALLAX, Per.

1901. Montserrat, near summit, San Geronimo (about 4000 ft.): *July* 15.—1 ♂ E. B. P.

Hitherto only recorded from Algeria, so far as I know.

OSMIA BIDENTATA, Mor.

1901. Barcelona: *July* 16.—1 ♀ E. B. P.
1902. Burgos, hill below Castle (about 3000 ft.): *July* 30.—1 ♀.

OSMIA ADUNCA, Pz.

1901. Port Bou: *June* 24.—7 ♀ A. H.
Barcelona: *July* 13.—2 ♂, 2 ♀ E. B. P.
1902. La Granja: *July* 23.—5 ♀. *July* 24.—1 ♂, 1 ♀.

OSMIA, sp. (?).

1901. Barcelona: *July* 13.—3 ♀ E. B. P., 3 ♀ W. H.

Osmia acuticornis, Duf. Perr. (?).

1901. Montserrat, Hospederia to San Geronimo (3000–4000 ft.): *July* 15.—1 ♀ E. B. P.

Osmia cœrulescens, L.

1901. Barcelona: *July* 13.—1 ♀ W. H. *July* 16.—1 ♀ A. H.
Montserrat, Hospederia to San Geronimo (3000–4000 ft.): *July* 15.—1 ♂ A. H.

Osmia aurulenta, Pz.

1901. Montserrat, near summit, San Geronimo (about 4000 ft.): *July* 15.—1 ♀ E. B. P., 1 ♀ W. H., 2 ♀ A. H.

Crocisa ramosa, Lep.

1901. Barcelona: *July* 16.—2 ♂, 1 ♀ E. B. P.

Podalirius fulvodimidiata, Dours.

1901. Cerbère: *July* 17.—1 ♂ E. B. P., 4 ♂, 3 ♀ W. H., 1 ♂ A. H.

Podalirius bimaculatus, Pz.

1902. La Granja: *July* 22.—1 ♂, 2 ♀. *July* 23.—1 ♂. *July* 24.—2 ♀.
El Escorial: *July* 28.—1 ♂, 1 ♀.

Podalirius garrulus, Rossi.

1901. Cerbère: *July* 17.—1 ♂ W. H., 1 ♀ A. H.
Montserrat, near Railway Terminus: *July* 14.—2 ♂ E. B. P., 1 ♂ A. H.

Podalirius albigenus, Lep.

1901. Cerbère: *July* 17.—1 ♂ W. H.
Port Bou: *June* 24.—1 ♂ E. B. P.
1902. La Granja: *July* 23.—4 ♂, 1 ♀. *July* 25.—1 ♀.

Podalirius 4-fasciatus, Vill.

1901. Port Bou: *June* 24.—1 ♀ E. B. P., 1 ♂ W. H., 2 ♂ A. H.
Barcelona: *June* 25.—1 ♀ E. B. P. *July* 13.—1 ♀ E. B. P., 1 ♀ A. H. *July* 16.—2 ♂, 2 ♀ E. B. P., 2 ♂ A. H.

PODALIRIUS CRASSIPES, Lep.

1901. Montserrat, near Railway Terminus: *July* 14. —1 ♂ E. B. P.
Montserrat, Hospederia to San Geronimo (3000–4000 ft.): *July* 15.—1 ♂ W. H., 3 ♂ E. B. P.
Montserrat, near summit, San Geronimo (about 4000 ft.): *July* 15.—2 ♂, 1 ♀ A. H.

PODALIRIUS PUBESCENS, F.

1902. La Granja: *July* 23.—4 ♂, 5 ♀. *July* 24.— 4 ♀. *July* 25.—1 ♀.

PODALIRIUS FEMORATUS, Oliv.

1902. La Granja: *July* 20.—1 ♂. *July* 22.—1 ♀.
La Granja: *July* 24.—1 ♂. *July* 25.—1 ♂.

PODALIRIUS RETUSUS, Linn. (?).

1902. La Granja, Palace Grounds: *July* 20.—1 ♀. *July* 22.—1 ♀.

The above determination is probable, but the specimens are so faded and weather-beaten that certainty is unattainable.

EUCERA COMMIXTA, D. T.

1902. La Granja: *July* 24.—1 ♀.

PSITHYRUS CAMPESTRIS, Panz.

1901. Montserrat, near summit, San Geronimo (about 4000 ft.): *July* 15.—1 ♂ E. B. P.

BOMBUS SMITHIANUS, White.

1901. Barcelona: *June* 25.—1 ♀ A. H. *July* 13.— 1 ♂, 3 ☿ W. H. *July* 16.—1 ☿ W. H.

BOMBUS AGRORUM, Fab. var.

The males are certainly *agrorum*, and probably therefore the females and workers are varieties of this species.

1901. Montserrat: *July* 14–16.—All forms abundant wherever the mountain was explored—from the Railway Terminus to the summit.

Bombus agrorum, var. pascuorum.

1902. La Granja: *July* 20.—1 ☿. *July* 22.—2 ☿.
Ditto, Palace Grounds: *July* 20.—1 ☿.
Ditto, above Palace: *July* 21.—5 ☿.

Bombus hortorum, L.

1901. Port Bou: *June* 25.—1 ♂ W. H., 3 ♂, 1 ☿ A. H.

Bombus hortorum, var. (posterior tibiæ red-haired).

1902. La Granja: *July* 20.—1 ☿.
El Escorial: *July* 28.—2 ♂, 4 ☿.

Bombus pratorum, L.

1901. Montserrat, near summit, San Geronimo (about 4000 ft.): *July* 15.—1 ♀ E. B. P.

Bombus terrestris, L.

1901. Barcelona: *July* 16.—1 ☿ W. H.
Montserrat, near Railway Terminus: *July* 13. —1 ☿ E. B. P.

Bombus terrestris, var. ferrugineus.

1901. Port Bou: *June* 24.—Abundant.
Barcelona: *July* 16.—1 ☿ E. B. P.
Montserrat, near summit, San Geronimo (about 4000 ft.): *July* 15.—1 ♂ W. H.
1902. La Granja: *July* 20.—2 ♀. *July* 26.—1 ☿.
El Escorial: *July* 28.—2 ☿.

Apis mellifica, L.

Fairly common everywhere.

[Freely devoured by the females, occasionally by the males, of *Dasypogon diadema* at La Granja. (Trans. Ent. Soc. Lond., 1902, p. 336, note.) E. B. P.]

APPENDIX.

The mimicry of Aculeata by the Asilidæ and Volucella, and its probable significance. By E. B. Poulton.

I have already stated that I was much struck with the mimetic resemblance borne by the Asilid captor to its Aculeate prey on July 20, 1902 (see p. 634). The commonest form of the variable female of *Dasypogon diadema* reproduces on a larger scale all the conspicuous features of *Pompilus viaticus*:—the dark wings and the black body with a reddish transverse band across the abdomen. In the case of *Pompilus fuscipennis* there is not even the discrepancy in size, while the resemblance in colour is in some respects even closer; for the red abdominal band is single in the *Pompilus*, and, although spread over three segments, appears to be single in the Asilid. In *P. viaticus*, however, the three constituent bands are evident, separated as they are by intervening black areas. This species of Asilid attacks Aculeates far more frequently than any other kind of prey. I observed it devouring small Coleoptera on several occasions at La Granja, once a Hemipteron, and once the male of its own species. In Switzerland I once captured it with a Tachinid fly (*Sarcophaga* sp., Trans. Ent. Soc. Lond., 1902, p. 334). On all other occasions when I have observed it, including the numerous instances recorded in the present memoir, the prey has been Hymenopterous—almost exclusively Aculeates, but now and then Ichneumons. The fact that the Asilid is a special enemy of the group to which *Pompilus* belongs suggests, at first sight, aggressive mimicry as the plausible interpretation of the resemblance—a likeness which may be supposed to facilitate the approach of the captor to its prey. But the swift and sudden swoop of an Asilid upon its victim does not appear to require any accessory aid; furthermore, there is no evidence that *Pompilus* is attacked above all other Aculeates. As a matter of fact this is the single example I have encountered. A surer interpretation of the resemblance seems to be afforded by protective mimicry—a defence against insect-eating vertebrate animals. The Asilid, seeking its prey, frequents places where Aculeates abound, and therefore an Aculeate is for

it a specially advantageous model, the likeness under such favourable conditions assisting it in the struggle with enemies against which the sting of *Pompilus* would be a defence. The striking and conspicuous colouring of this Aculeate renders it especially suitable as a model. Furthermore, the detailed resemblance may have been built up on a foundation provided by a slightly greater initial resemblance to this rather than any other Aculeate genus.

This appears to be the most feasible explanation of Asilid mimicy as a whole. *Asilidæ* which have no special form of insect prey, but attack indiscriminately, are not as a rule mimetic. Such an exception as our own *Asilus crabroniformis* recalls in a general way the type of Aculeate colouring and pattern which is commonest and most conspicuous in its region, and is probably therefore independent of the advantages due to special association. Neither do we find mimicry prevalent among the *Asilidæ* which exhibit decided preferences, but not in the direction of specially-defended prey, such, for instance, as *Dysmachus trigonus*, which clearly selected a much less abundant beetle (*Rhizotrogus sauzi* (?), Graells), among the swarms of Orthoptera towards the summit of Peñalara, on July 25, 1902. Mimicry, on the other hand, is common among these predaceous Diptera when they attack the Hymenoptera in any special degree. We can probably distinguish two classes of mimetic resemblances among such Asilid flies. In the first we may place *Dasypogon diadema* and the slender ichneumon-like Dioctrias which, as Colonel Yerbury has observed (l. c., pp. 332, 333), specially select ichneumons as their prey—in fact, all examples in which the attacks are upon a group rather than upon a particular species. The second class, in which mimicry is even more common and more exact in its details, comprises the *Asilidæ* which specially attack single species of Aculeates, such, for instance, as *Damalina* sp., described by Col. C. T. Bingham as preying upon the model (*Melipona apicalis*), which it resembles with extraordinary precision (l. c., p. 334). Further examples are probably to be found in the Hyperechias, which bear so wonderfully perfect a resemblance to the *Xylocopidæ*, and, as is believed, prey upon these Aculeates. Indeed, Mr. E. E. Green has only recently observed one circling round its Xylocopid model in Ceylon (Proc. Ent. Soc. Lond., 1904, June 1). It is unfortunate that the

remarkable likeness to such common insects should convey an impression of extreme rarity and lead to a want of knowledge as to habits. Asilid mimicry of this latter kind may be exactly paralleled by resemblances such as that of the Histerid *Saprinus virescens* to its distasteful Phytophagous prey, *Phædon cochleariæ*,—following the convincing interpretation offered by Mr. Horace Donisthorpe (Trans. Ent. Soc. Lond., 1901, p. 354).

The resemblance of the Volucellas for the Aculeates has probably been brought about in a slightly different way, although here too the older interpretation of the mimicry as aggressive must, I believe, be abandoned. My friend Dr. W. Hatchett Jackson has recently presented to the Hope Department a specimen of *Volucella inanis*, which he captured on August 29, 1903, close to the entrance of a wasps' nest in his garden at Pen Wartha, Weston-super-Mare. The wasps paid not the slightest attention to it, although they instantly attacked other insects venturing near the opening. Considering that wasps will detect and kill the individuals from other communities, it is most improbable that they were deceived by the appearance of the *Volucella*. Furthermore, Dr. Jackson has had the opportunity of studying M. Fabre's latest volume, and informs me that the great observer believes *V. inanis* to be a beneficial guest in the wasps' nest, feeding on débris, waste substances, excreta, etc. He also states that the larvæ of these diptera are not attacked even when upon the combs of the wasp. These results entirely accord with observations upon *V. bombylans* carried out by the present writer in association with Miss Cora B. Sanders early in July 1898. Fresh and active specimens of the *Volucella* were lightly but securely girdled with a fine silken thread, the other end being attached to a long slender twig. In this way it was possible to guide the movements of the fly and compel it to wander close to the opening of the underground nest of *Bombus terrestris*, and even to enter the passage. Examples of both the red-tailed form of *V. bombylans* and the banded form (var. *mystacea*) were thus tested, and only once was any antagonism displayed. On this occasion the *Volucella* was made to descend the passage, and thus met an ascending worker. The humble-bee grappled with the fly, wrestled with it in a clumsy manner for a few seconds, and then left it apparently without having caused any injury. We also

witnessed the oviposition of the *banded* variety *mystacea* in the nest of a *red-tailed* carder-bee (*Bombus derhamellus*, Kirb.). The fly hovered round the nest for a few seconds, the bees paying no attention to it. It then alighted on the moss and quickly entered, remaining about *eight* minutes. At the close of this period it emerged, and at once flew away. Opening the moss below the point of its entrance and exit, about fifty or sixty eggs were found in a mass. These were exactly similar to the eggs sometimes laid by captured females of the species of *Volucella*. The fact that a banded fly should have laid in the nest of a red-tailed bee strongly opposes the interpretation of aggressive mimicry, originally offered by Kirby and Spence and followed by the present writer in former publications (*e. g.* "Colours of Animals," London, 1890, p. 267).

Another observation made on the same occasion also opposes the older interpretation. It is well known that the Aculeate models, when disturbed, commonly adopt a warning attitude in which the second leg is raised. On further irritation the whole body is generally tilted over on one side. In the sun *Volucella* is shy and readily takes flight; but on cold days and in the evening it becomes sluggish and semi-torpid. If disturbed in this condition I found that it raises its first leg in a manner clearly mimetic of the first warning position of its *Bombus* model. The anterior legs of flies perform such a variety of operations that selection would here have a comparatively easy task to produce a new movement of a simple kind. At the same time the general likeness of the attitudes is very striking, although different legs are made use of by model and mimic.

The protective value of such a detail in the resemblance of fly to *Bombus* becomes sufficiently obvious, when it is remembered that the position is only assumed at a time of complete helplessness. On the other hand, it is most improbable that an attitude thus assumed could play a part in the aggressive mimicry of the one insect for the other.

The facts now brought forward supply a solid foundation for the criticism of the older conclusions urged, in 1893, by Mr. W. Bateson, F.R.S. ("Nature," 1892, Vol. xlvi, p. 585, Vol. xlvii, p. 77).

It is probable that the Volucellas, like the Asilids, are protected from insect-eating animals by their mimetic disguise, and that the resemblance of *V. inanis* to wasps

and of *V. bombylans* to the red-tailed and banded humble-bees have been promoted by the special associations which render the models peculiarly feasible in each respective case. These Diptera live in the same habitats as their models, and may be seen visiting the same flowers; they fly from nest to nest to deposit their eggs, and their first flight on emergence from the puparium is made from the home of an Aculeate community. It is obvious that their mode of life bears a strong superficial resemblance to that of their respective hosts, and that mimetic likeness to these hosts would be far more convincing and advantageous than to other species of Aculeates.

Although mimicry is not necessarily dependent on a mode of life which brings an insect into intimate relationship with some widely-different form possessed of special means of defence, yet such associations are very commonly attended by mimicry. In this note it has been seen that mimetic likeness may result when the relationship is that between captor and prey, whether the prey be defended by a sting or by some nauseous quality—that it may result when the association is that of scavenger to an Aculeate host.

E. B. P.

VIII. *Notes upon some remarkable parasitic insects from North Queensland.* By F. P. DODD, F.E.S.; *with an Appendix containing descriptions of New Species, by* COLONEL CHARLES T. BINGHAM, F.Z.S., and DR. BENNO WANDOLLECK.

[Read March 7th, 1906.]

HYMENOPTERA PARASITICA.

[THE material upon which the following interesting observations have been made has been kindly placed in my hands by the author, with the desire that I should make it available for the use of naturalists. Inasmuch as it mainly bears upon those bionomic questions which are so much studied at Oxford, the great majority of the specimens have been placed in the Hope Department; but wherever possible, co-types of the new species have been deposited in the British Museum of Natural History. The type of the interesting Cyrtid fly, *Ogcodes doddi*, has been added to Dr. Wandolleck's famous collection of this group at Dresden.

Mr. Dodd is to be congratulated upon these carefully-recorded observations throwing so much new light upon many of the North Australian Hymenoptera Parasitica. The hosts of the extraordinary Chalcid genus *Schizaspidea* have been hitherto unknown; we here find that *S. doddi* is parasitic upon ants. In other cases, such as the Chalcidid genus *Rhipipallus* and the Cyrtid fly, the general group to which the host belongs is already known, but Mr. Dodd furnishes us with exact data of the utmost value and interest. Many observations here recorded show a remarkable and long-persistent vitality in larvæ attacked by Braconid parasites. It is probable that in hot latitudes, where a dead insect would quickly dry up and in other ways deteriorate as food, the attacks of parasites have been specially adapted to prolong the victim's life to its very utmost. The adaptation of course always exists, but here we probably see it at its highest level.

It is unnecessary to specify any localities, inasmuch as

the whole of the material was collected by Mr. Dodd at Townsville, North Queensland.—E. B. POULTON.]

Nos. 1 and 2 are from the caterpillars of *Delias argenthona*, F. The larvæ of the larger species (No. 1) push their way through the sides of their host, and at once commence to construct their cocoons in a mass, the caterpillar dying and shrivelling up very quickly. The flies emerge through the end of the cocoon by forcing open the lid. The eggs of the smaller species are, I suppose, deposited upon the larvæ of the larger ere they are secure in the cocoons: they do not push open the lid, but gnaw holes to escape.

[Colonel C. T. Bingham has kindly described the Braconid parasite (No. 1) as *Apanteles deliadis* (Appendix, p. 125); the Chalcidid hyperparasite (No. 2) as *Microterys cæruleus* (Appendix, p. 127). Four Bracons and three Chalcids bear the date Jan. 2, 1903; seven Chalcids, Jan. 6, 1903; and nine Chalcids Jan. 9, 1903.]

No. 3.—From *Chærocampa oldenlandiæ*, F. [*Theretra oldenlandiæ firmata* (Walk.), Rothschild and Jordan, Rev. Sphing., Nov. Zool., ix, suppl., p. 783.] In this (and two following species) only a single parasite attacks the caterpillar. The larva emerges through the side of its victim, and spins a cocoon, like a full grain of wheat, crosswise upon the back, just in front of the horn. The caterpillar never moves from one spot, and lingers until some time after the parasite has flown. The caterpillar, which is exhibited *in formalin*, did not die until forty-eight hours after the emergence of the fly, and I found it, with the cocoon seemingly finished, seven days before the appearance of the Hymenopterous insect.

[Col. Bingham has described this Braconid parasite as *Microgaster basalis* (Appendix, p. 125). The single specimen with its oval cocoon, from which a terminal lid has been pushed off, bears the date Feb. 11, 1903.]

No. 4.—Host *Notodonta* [*Cerura*] *cycnoptera*, Lower. The larva of this insect comes through the side or back of the caterpillar: it rears itself nearly upright and is almost entirely outside the aperture when it constructs the cocoon, which leans backwards at an angle of about forty-five degrees. Some twenty or twenty-four hours after, when the cocoon appears to be complete, the larva contrives to move its case from the host's back to the leaf. Wondering how this transference could be effected, I examined the

case before removal, and observed that there was a tiny hole, through which the larva could push its head. The imago emerges through a lid in the upper end. The caterpillar never shifts from the position it has taken up, along the midrib on the under-side of the leaf. Like the preceding and following species it is very irritable. Death takes place about the sixth day, generally a day or so before the fly emerges; but I have found a caterpillar still alive after the fly had gone. One cocoon produced a number of minute Hymenoptera which are shown together with the case from which they had bored their way. *In formalin* several of the stung caterpillars are exhibited, each showing the wound caused by the full-grown Hymenopterous larva in its exit.

[Colonel Bingham has described the Braconid parasite (No. 4) as *Microgaster perelegans* (Appendix, p. 126). The minute hyperparasites are shrivelled and indeterminable.

Two cocoons (one attached to piece of leaf), 1 Braconid and 5 hyperparasites bear the date Feb. 26, 1902.

One cocoon, 1 Braconid and 5 hyperparasites bear the date Feb. 27, 1902.

One cocoon, 1 Braconid, 5 hyperparasites, and 1 caterpillar of *Notodonta*, bear the date March 2, 1902.

Three cocoons and 1 Braconid bear March 11, 1902.

Four of the cocoons have been opened by pushing off a terminal lid. The lids have been preserved with their respective cocoons in three examples. The cocoon on the leaf has not been opened by a lid, but bears two minute apertures, one in the side and one near the end. It is probable that the fifteen hyperparasites emerged through these holes. Two cocoons, dated March 11, 1902, had not been opened from within. These two, unlike the others, are strongly marked by longitudinal furrows, and bear the appearance of a distinct cap at one end, clearly marked off from the rest of the cocoon by a circular ridge. They also differ from the other five cocoons in wanting the oblique flattened area towards one end which doubtless marks the base of attachment to the surface of a leaf.]

No. 5.—Host the bee-hawk *Hemaris kingi* [*Cephonodes kingi*, McLeay, of Rothschild and Jordan, Revision, p. 463.] This larva also places the cocoon across the back of the caterpillar immediately in front of the horn. One day I noticed three small caterpillars upon twigs: the next day in passing I found that each carried a case. I then took

them and observed that after several days the cocoons had dropped off. The parasites appeared in the perfect state on the eighth day, the first caterpillar dying two days, the second five days and the third eight days after the appearance of their respective parasites. The third caterpillar seemed dead on the seventh day, but movements were noticeable in the claspers during this and well into the eighth day.

It will be noticed that this and the two preceding species of caterpillars must be stung when they are exceedingly small, for they are all only about the size of healthy eight- or nine-days-old larvæ.

I had another species of these flies from a common noctuid (*Achæa* sp.). The larva came out under the twelfth or thirteenth segment and affixed its cocoon to the twig, the caterpillar's tail being raised to accommodate it and pressing on and partly around it. In this position the caterpillar remained, though not fastened to the case in any way, it died on the third or fourth day after the appearance of the Hymenopterous imago.

[This Braconid parasite (No. 5) has been described by Col. Bingham as *Microgaster basalis,* viz. the same species as No. 3, also parasitic upon the caterpillar of a hawk-moth (Appendix, p. 125). The single specimen of No. 5 together with its cocoon bears the date Feb. 19, 1902. The cocoon has lost its terminal lid.]

No. 6.—From the handsome Lycænid *Ogyris genoveva,* Hew. [a synonym of *O. zosine,* Hew.] The larvæ of this butterfly are befriended by several species of ants, chiefly by a large *Camponotus,* in whose nests they pass the day. When young however they hide under loose bark or in crevices, and can easily be stung by small parasites. The numerous larvæ crawl out from under the host and form their heap of cocoons, the victim dying very slowly. The flies emerge in about seven days, the caterpillars having a little life left in them up to five days later.

[This Braconid parasite (No. 6) has been described by Col. Bingham as *Protapanteles rufiventris* (Appendix, p. 127). Five Braconids, 1 shrivelled Lycænid larva, and 7 cocoons bear the date March 21, 1902; 5 Braconids and a heap of many cocoons bear Dec. 22, 1902; five Braconids and another large heap bear Dec. 23, 1902. The white oval cocoons have been opened by pushing off a terminal lid which in many cases remains attached as it were by a

slight hinge. When the cocoons are affixed end to end in the heap, the lids appear to be always formed and pushed off at the free ends.]

Nos. 7 and 8.—From the pupæ of the case moth *Ardiosteres moretonella*, Walk., the larvæ of which live in the nests of small black tree ants. The Lepidopterous larvæ never leave these nests; but in order to pupate they approach closely to the entrances, when they are, no doubt, victimised.

[No. 7 is borne by the following undated set of specimens: a Lepidopterous case from which the empty pupal skin of a moth projects, so that this particular specimen was not parasitised; 2 ♀ *Chalcididæ* described by Col. Bingham as *Stomatoceras fasciatipennis* (Appendix, p. 128); 4 ants identified by Prof. Auguste Forel as *Cremastogaster læviceps*, Smith.

No. 8 is borne by a set of specimens dated June 5, 1902: 2 flattened dumb-bell-shaped Lepidopterous cocoons the larger of which has been pierced by an emerging parasite, the other very small; 1 Chalcidid considered by Col. Bingham to be probably a species of *Halticella*, but too fragile to bear removal from the card for examination; 2 *Cremastogaster læviceps*, Smith, ☿.]

No. 9.—These bright little Chalcididæ I have bred frequently from the pupæ of the fine long-jawed ant *Odontomachus* sp., several sometimes coming from the one cocoon.

[No. 9 is borne by 2 ♀ and 1 ♂ Chalcididæ described by Col. Bingham as *Rhipipallus affinis* (Appendix, p. 129). They are dated July 30, 1902. Another set of specimens, without number, but dated March 16, 1902, contains 1 ♂ and 1 ♀ of the same species of Chalcidid, 1 worker ant identified by Prof. Forel as *Odontomachus ruficeps*, Sm., subsp. *coriarius*, Mayr., ☿, and 1 ant cocoon. A third unnumbered set, dated Oct. 1902, contains 1 ♂ and 2 ♀ of the Chalcidids, and 1 worker of the above-named species of ant.]

No. 10 is a great rarity and the only specimen I have bred from several lots of pupæ of a large ant, *Camponotus* sp. From one lot I obtained some large bright pink mites, but I lost these in a great cyclone on March 9, 1903.

[No. 10 is borne by the ♂ of a beautiful and remarkable Chalcidid described by Col. Bingham as *Schizaspidia doddi* (Appendix, p. 130). It is dated Jan. 1903.]

Diptera.

No. 11.—In the crevices of the leaf nests of our interesting green ant, *Œcophylla virescens*, Fabr., a pretty jumping spider takes shelter and breeds. Generally it selects the nests which are partly abandoned. I was carding some of these spiders, but one ♀ being rather bulky, seemingly with eggs, I kept her in a glass-bottomed box to deposit them. One morning I found the spider dead, with abdomen strangely small and shrunken, and, instead of a mass of eggs, I noticed a peculiar dark object in a thin web the spider had spun. Later in the day the object became much lighter and I made it out to be a short thick pupa of some kind, not unlike that of a butterfly. Finally in about twelve days' time the pupa produced the dipteron now shown. The exact dates, and box carefully preserved with pupal shell in the web, were lost in the storm already alluded to, owing to the destruction of the house I lived in, when various entomological specimens of interest were destroyed.

[No. 11 is borne by an Attid spider kindly identified by my friend Dr. G. W. Peckham, of Milwaukee, as *Cosmophasis bitæniata*, Keys. Dr. Peckham informs me that the ♂ = *Sobara bitæniata*, and the ♀ = *Seleaphora rubra*, in Koch and Keyserling's "Arachn. Austral.," p. 1365, and p. 1374. The specimen, which is dated Nov. 15, 1902, has a shrivelled abdomen, and bears the word "Dipteron," so it is certainly the host of the Cyrtid fly, *Ogcodes doddi*, Wandolleck, sent with it. The *Ogcodes* bears the locality and date, Nov. 20, 1902. (See Appendix, p. 131.)

No. 11 is also borne by two more spiders of the same species, dated Nov. 11, 1902.]

APPENDIX.

1. *New species of* Braconidæ and Chalcididæ *from N. Queensland, bred by* F. P. DODD. By Colonel CHARLES T. BINGHAM, F.Z.S.

BRACONIDÆ.

No. 1. APANTELES DELIADIS, form. nov.

♀. Head broader than long, face below the antennæ slightly raised, front and vertex smooth, occiput not margined. Thorax short, broad anteriorly, pro- and mesonotum and scutellum minutely but very closely punctured; wings hyaline and iridescent, legs long, posterior tibiæ slightly incrassate. Abdomen short irregularly obliquely truncate at apex, compressed, ovipositor slightly exserted. Black; antennæ reddish-brown; the trochanters, femora, tibiæ and tarsi of the legs, and the basal three segments of the abdomen on the sides, dark brownish-yellow.

♂. Similar in sculpture and colouring to the ♀ but the abdomen is vertically not obliquely truncate.

Length ♀ $3\frac{1}{2}$ mm., of ovipositor $\frac{1}{2}$ mm.: ♂ 3 mm.

Exp. ♂ ♀ 5 mm.

♂ and ♀ types in Hope Department, Oxford University Museum: ♂ and ♀ co-types in British Museum of Natural History.

Hab. N. QUEENSLAND, Townsville (*F. P. Dodd*).

A true *Apanteles*, with the antennæ 18-jointed, eyes minutely pilose, and the radial and cubital abscissi faintly marked. No form of the genus has, so far as I know, been previously recorded from Australia.

The hyperparasites (No. 2) of the above species belong to a new species of *Chalcididæ* described on page 127 as *Microterys cœrulescens.*

Nos. 3 and 5. MICROGASTER BASALIS, form. nov.

♂. Head smooth and shining, vertex broad, ocelli prominent. Antennæ elongate 18-jointed densely pilose. Thorax broad, gibbous anteriorly, smooth; mesonotum with two longitudinal short deep impressed lines, mesopleuræ not furrowed smooth; scutellum

triangular, its apex blunt; median segment posteriorly rounded vertically tricarinate and coarsely cribrate between the carinæ. Wings: apical two-thirds fuscous, basal third hyaline; legs normal except for the posterior femora and tibiæ which are somewhat thickened, pilose. Abdomen: broad, depressed, basal segment superficially lightly and finely punctured, the rest smooth and shining. Head black, antennæ brown, basal joint red; thorax red; anterior and intermediate legs and coxæ and trochanters of posterior pair pale brownish-yellow, femora tibiæ and tarsi of posterior legs dark brown. Abdomen basal segment and sides of 2nd and 3rd segments yellow, remainder of the abdomen jet black.

Length ♂ 5 mm. Exp. 12 mm.

♂ type (No. 3) and co-type (No. 5) in Hope Department, the former from a *Chærocampa*, the latter from a *Hemaris* larva.

Hab. N. QUEENSLAND, Townsville (*F. P. Dodd*).

Belongs to Marshall's Section 2 of the genus.

No. 4. MICROGASTER PERELEGANS, form. nov.

♀. Head: face in front, vertex and behind the eyes closely but very minutely punctured; antennæ 18-jointed densely pilose; thorax smooth or with only a few scattered punctures anteriorly, the mesonotum and scutellum separated by a conspicuous short broad transverse furrow the two sides of which are medially connected by cross carinæ; scutellum triangular smooth; median segment obliquely truncate, coarsely cribrate, and with a medial and a lateral (one on each side) prominent vertical carina; wings hyaline lightly infuscate; legs long, posterior pair slightly pilose. Abdomen depressed, polished and shining above. Head median segment and abdomen jet black; thorax anteriorly and up to the scutellum red; legs: anterior and intermediate pair reddish-yellow, posterior pair black with a broad sub-basal ring on the tibia white; sides of 1st and 2nd segments of the abdomen yellowish-white; ovipositor black scarcely exserted.

♂. Similar except that the abdomen is slightly more depressed and there is of course no ovipositor.

Length ♀ ♂ 4 mm. Exp. 9 mm.

♂ and ♀ types in Hope Department, ♂ co-type in British Museum of Natural History.

Hab. N. QUEENSLAND, Townsville (*F. P. Dodd*).

Belongs to Marshall's Section 1 of the genus with the basal segment longer than its breadth at apex and the 2nd cubital cell subtriangular and open.

The minute hyperparasites sent with this are shrivelled and indeterminable.

No. 6. PROTAPANTELES RUFIVENTRIS, form. nov.

♀. Head lightly punctured; face medially carinate below the eyes; antennæ long, pilose, 18-jointed. Thorax shining broad and gibbous, anteriorly finely punctured; scutellum triangular convex divided from the mesonotum by a short broad transverse furrow and with a punctured very narrow groove bordering both sides and meeting at the apex; median segment not carinate oblique, slightly convex, somewhat more closely and coarsely punctured than the pro- and mesonotum; wings hyaline iridescent; legs robust, posterior femora somewhat compressed. Abdomen broad, basal two segments punctured like the median segment, remainder smooth and shining, apex rounded, ovipositor only slightly exserted.

Head, thorax and median segment black; antennæ reddish-brown; legs and abdomen brownish-yellow, basal segment reddish-brown above, apical segment shaded with fuscous.

♂. Similar, slightly smaller; abdomen shorter and more truncate posteriorly.

Length ♀ 4, ♂ 3 mm. Exp. ♀ ♂ 9 mm.

Types in Hope Department, co-types in British Museum of Natural History.

Hab. N. QUEENSLAND, Townsville (*F. P. Dodd*).

This agrees in generic characters with *Protapanteles*, Ashmead. In the classificatory tables given by this author in the Proceedings of the United States National Museum, vol. xxiii, pp. 1–220 (1900), the presence or absence of a longitudinal carina on the median segment is given as the chief point of difference between the genera *Apanteles* and *Protapanteles*. The present form differs from *Apanteles deliadis* (*supra*), besides other characters, in the much more lengthened median segment.

CHALCIDIDÆ.

No. 2. MICROTERYS CŒRULEUS, form. nov.

♀. Head, thorax and abdomen smooth and shining, the face in front and the prothorax anteriorly with a few scattered punctures.

Antennæ 7-jointed, scape smooth flagellum pilose opaque, the joints distinct; eyes large, bulging out on either side of the head. Thorax, sutures between pro- and mesonotum, scutellum, postscutellum and median segment distinct; wings hyaline iridescent; legs slender. Abdomen lanceolate apically acute, above depressed, concave, ovipositor not exserted. Head, thorax and abdomen metallic-blue, flagellum of the antennæ and the femora of the legs except at apex dark brown, scape of the antennæ and apex of femora, tibiæ and tarsi pale yellow.

♂. Only differs from the ♀ in being smaller, the antennæ are 10-jointed with the flagellum more densely pilose; head and thorax minutely but densely punctured, and the abdomen short, rounded posteriorly, not acute.

Length ♀ $2\frac{1}{4}$, ♂ $1\frac{1}{2}$ mm. Exp. ♂ ♀ 4 mm.

Types in Hope Department; co-types in British Museum of Natural History.

Hab. N. QUEENSLAND, Townsville (*F. P. Dodd*).

Hyperparasitic upon *Apanteles deliadis* (page 125).

No. 7. STOMATOCERAS FASCIATIPENNIS, form. nov.

♀. Head and thorax closely and evenly punctured. Clypeus and face below the base of the antennæ cribrate; face and front above the base of the antennæ deeply and widely vertically sulcate, the furrow bordered on each side and above, just below the vertex, by a well-marked carina; scape of antennæ long about one-third of the whole length of the latter, smooth but minutely pilose, flagellum simple, granulose, 10-jointed. Thorax: robust, pronotum margined anteriorly; scutellum large oval convex overhanging the median segment, bidentate at apex, posteriorly with a very narrow sub-marginal furrow or channel; median segment short, truncate, bearing on its posterior vertical face a median looped carina and two lateral oblique carinæ; wings hyaline with sub-basal and post-median broad transverse fuscous fasciæ; legs minutely pilose, posterior femora edged posteriorly with numerous extremely minute teeth. Abdomen subsessile smooth and shining, the basal abdominal segment as long as the rest united. Head, thorax and dorsal surface of abdomen black; apex of scape of antennæ, tegulæ of wings, the legs, and sides and ventral surface of abdomen blood-red.

Length ♀ 5 mm. Exp. 8 mm.

♀ type in Hope Department.

Hab. N. QUEENSLAND, Townsville (*F. P. Dodd*).

Stomatoceras, Kirby, is another widespread genus occurring in Africa, Japan, and America, and now recorded from Australia.

No. 8. The single specimen of this Chalcidid is too fragile to remove from the card for examination. It probably belongs to the genus *Halticella.*

No. 9. Rhipipallus affinis, form. nov.

♂. Head lenticular; clypeus triangular deeply incised anteriorly, front below the antennæ slightly raised, smooth and shining, cheeks face and vertex finely but somewhat obsoletely longitudinally striate; scape of antennæ short smooth and shining, flagellum finely granulose, pilose, the hairs very short, the basal two joints simple, the rest except the apical joint with long slightly clavate rami on each side, two to each joint, apex distinctly incrassate. Thorax densely and somewhat coarsely punctured; scutellum conical produced, the apex terminating in two short teeth; at base a tranverse series of foveæ or large shallow punctures; postscutellum and median segment very coarsely cribrate, the latter with two or three irregular more or less vertical carinæ; wings hyaline and iridescent; legs slender. Abdomen smooth and shining, its petiole opaque granulose. Mandibles tibiæ and tarsi pale yellowish-brown; coxæ and femora dark blue or black; antennæ dark reddish-brown; head, thorax anteriorly, scutellum and median segment, metallic-green with in certain lights a bronze tint; middle of thorax above entirely coppery-bronze; petiole and abdomen dark metallic-blue.

♀. differs from the ♂ as follows: Clypeus not incised; antennæ moniliform, the joints simple not provided with lateral rami; scutellum not bidentate at apex, at base a deep, broad transverse sulcation within which is situated the transverse series of foveæ so conspicuous in the ♂; petiole of abdomen much shorter, abdomen as in the ♂. Antennæ paler, head and thorax more bronze than green; abdomen a darker blue.

Length ♂ 5; ♀ 4 mm. Exp. ♂ ♀ 9 mm.

♂ ♀ types in the Hope Department, ♂ ♀ co-types in British Museum of Natural History.

Hab. N. Queensland, Townsville (*F. P. Dodd*).

Superficially this form closely resembles the type of the genus (*R. volusus,* Walker), but besides other points of difference it is easily separable by the sculpture of the

thorax, which in *volusus* has the humeral angles of the thorax conspicuously smooth and shining, not coarsely punctured and no carinæ on the median segment.

No. 10. SCHIZASPIDIA DODDI, form. nov.

♂. Mandibles sickle-shaped with three teeth, apical tooth long acute, two small teeth on the inner margin; clypeus short quadrate with the cheeks and face below the base of the antennæ transversely striate, the striæ curving round upwards and becoming vertical behind and between the eyes, vertex longtitudinally striate; scape of antennæ smooth, flagellum finely granulose, 1st joint simple rounded, remaining joints throwing outwards comparatively short, slightly clavate rami. Thorax: short and stout, densely and somewhat deeply punctured; scutellum: produced elongate conical overhanging the median segment and bearing a stout bifurcate process at apex, the points of the fork blunt with a tooth on the inner side of each; postscutellum and median segment vertical and vertically striate the division between them well marked. Abdomen petiolate, petiole shorter than the rest of the abdomen which is subobconical depressed above and broad and bluntly rounded posteriorly. Mandibles, scape of antennæ, and coxæ, femora, tibiæ and tarsi of the legs pale yellowish-brown, flagellum darker brown; head and thorax rich golden bronze with in certain lights scattered green and purple points; wings hyaline iridescent; abdomen shining bronze-brown.

Length ♂ 5 mm. Exp. 12 mm.

♂ type in Hope Department.

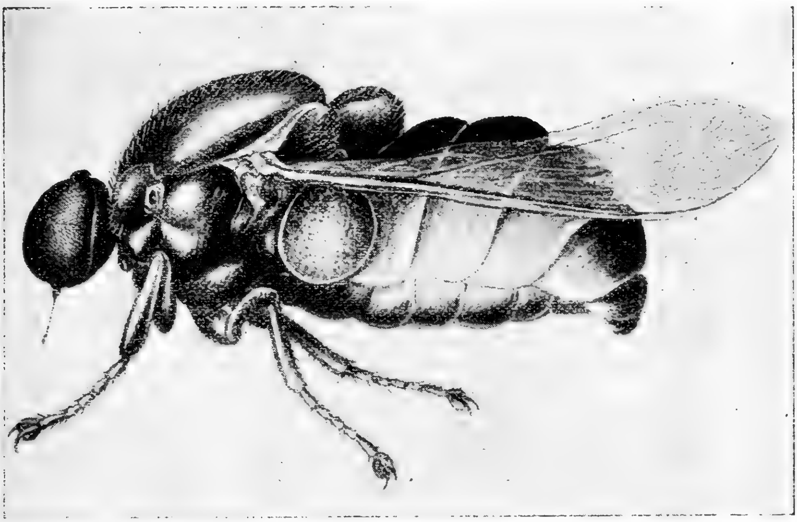
Hab. N. QUEENSLAND, Townsville (*F. P. Dodd*).

Schizaspidia, Westw., is a genus, so far as is recorded, of small extent but wide distribution: forms of it occur in Australia, the Philippines, India and South America.

2. *A new species of* Cyrtidæ (Diptera) *from N. Queensland, bred by* F. P. DODD. By Dr. BENNO WANDOLLECK, of Dresden.

OGCODES DODDI, n. sp.

♂ (?) N.E. AUSTRALIA.

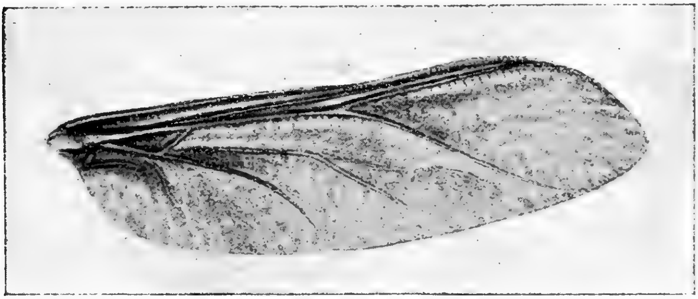


Ogcodes doddi, n. sp.

A small species, allied to *Og. darwini*, Westw.

Body brown, grey-haired. Head black, ocellar tubercle prominent and polished. The facets are of equal size. The horizontal groove of the eyes longer than in *Og. darwini.* Neighbourhood of the mouth grey tomentose, thickened, with a deep vertical notch. Antennæ small, the onion-shaped part of the third joint dark brown, the remaining part light brown and transparent. Thorax brown, smooth, grey-haired. Prothoracic plates small, light brown. Wings brownish; veins stout, brown; squamæ of the same

colour as the wings, with a stout brownish margin; grey-haired. Legs light brown; tarsi darker; claws and pulvilli blackish-brown; abdomen light brown; tergites yellowish with a narrow white band in



Wing of *Ogcodes doddi.*

front; middle of the first and second sternite yellow, the other sternites mottled with dark yellow patches; margins yellowish-white.

Length 4 mm.

EXTRACTS FROM THE PROCEEDINGS

OF THE

ENTOMOLOGICAL SOCIETY OF LONDON

(December 24th, 1903).

October 7th, 1903.

Mr. Roland Trimen, F.R.S., exhibited some cases of mimicry between butterflies inhabiting the Kavirondo-Nandi district of the Uganda British Protectorate, particularly that in which *Planema poggei*, Dewitz, is imitated by an apparent variety of *Pseudacræa künowii*, Dewitz, and also by a hitherto undescribed form of the polymorphic ♀ *Papilio merope*, Cram. He mentioned that both *Planema poggei* and *Pseudacræa künowii* were described and figured by Dewitz in 1879 from single specimens taken by Dr. Pogge in Angola, and added the interesting fact that the only other example of the undescribed mimicking form of the ♀ *Papilio merope* known to him—in the Hope Department of the Oxford University Museum—is ticketed "Angola; Rogers, 1873." Now, all three butterflies had been found as far to the eastward as Uganda, the *Planema* apparently not uncommonly, but its two mimickers very rarely indeed, by Mr. C. W. Hobley, of Kisumu.

This case was of special interest because it was the first brought to notice of the mimicry of one of the *Acræinæ* by a ♀ *Papilio* of the *merope*-group of the genus, members of the Danaine genera *Amauris* and *Danais* being the known models copied. Yet it must not be forgotten that the extremely rare form of ♀ of the Abyssinian *Pap. antinorii*, Oberthür, named *Ruspinæ* by Kheil, mimicked the moth *Aletis helcita* more closely than it did *Danais chrysippus*; and the large number of variations in various directions from the principal and pronounced mimicking forms of the *merope*-group indicated

plainly how plastic and adaptable they remain for modification in any advantageous direction.

Planema poggei was one of the largest species of its genus, and must be very conspicuous in life owing to the very broad postmedian transverse rich ochre-yellow band of the fore-wings in contrast with the white median band of the hind-wings. The *Pseudacræa*—which Mr. TRIMEN referred with some hesitation to *Ps. künowii*, on account of the different markings on the under-side of the fore-wings in the premedian area—was an excellent mimic of the *Planema* in every way, except in the narrower white band of its hind-wings. In Mr. Hobley's large collection only one example (♀) of this *Pseudacræa* occurred, and similarly only one of the undescribed form of the ♀ *Pap. merope.*

The characters of the last mentioned were the following, *vid.* :—

Fore-wing: *markings rich deep ochre-yellow,—the sub-apical bar, disco-cellular streak, and much narrowed, but superiorly prolonged inner-marginal patch being confluent into a wide discal band* very irregular in outline; some slight fuscous scaling on yellow band between 2nd and third median nervules indicates the normally wide separation between the sub-apical and inner-marginal markings; ordinary apical spot wanting; two small sub-marginal spots respectively above and below 2nd median nervule of the same ochre-yellow as the discal band. *Hind-wing*: white patch from base outward much restricted, barely reaching middle and extending only just beyond extremity of discoidal cell; sub-marginal spots all dull ochre-yellow except the three next apex which are white. *Under-side*: Apex of fore-wing and all outer area of hind-wing of a paler brown than in the form *Hippocoon.* *Fore-wing*: ochre-yellow bar as above but rather paler, and with scarcely any fuscous scaling between 2nd and 3rd median nervules; an additional sub-marginal very small ochre-yellow spot close to posterior angle. *Hind-wing*: restricted white patch as above, but much duller.

The second example (from Angola) of this form of the ♀ *merope* agreed very nearly with the Uganda specimen above described, only differing in the rather duller ochre-yellow of

the band in the fore-wings; in the presence in the same wings of a very small ochre-yellow apical spot, and of a similar spot close to the posterior angle on the upper-side; and on the under-side the increase of the fuscous scaling about 2nd median nervule, so as almost to interrupt the yellow discal band.

This made the *fourth* pronounced known form of the ♀ *Papilio merope.* The usual and generally distributed form of this sex throughout Tropical Africa was that named *Hippocoon*, by Fabricius—an excellent mimic of *Amauris niavius*, L.; all the other forms appeared to be very rare, and two of them —*Dionysos*, Doubl., and the form from Zanzibar described in Mr. Trimen's Presidential Address to the Society on January 19, 1898—were not direct mimics of any other butterflies, but were least divergent from the non-mimetic coloration and pattern of the male. The form which he now brought to notice was, on the contrary, a direct and unmistakable mimic of *Planema poggei*; and, as it was inconvenient to refer to the mimetic forms without assigning names to them, he proposed to style this form *Planemoïdes*.

The President congratulated Mr. Trimen on the exhibit, and the special interest attaching to an interpretation of this remarkable form of the female *merope.* The Society would sympathize with the feelings of the author of the original discovery brought before the scientific world, more than thirty-five years ago, of the most remarkable of all examples of mimicry in Rhopalocera, that of *merope* and its allies, as he saw before him for the first time this mysterious form accompanied by its model. At the same time it was only just to a younger worker, who had been in great part guided by Mr. Trimen's classical monographs, to point out that the interpretation so convincingly illustrated that evening had been made out last spring by Mr. S. A. Neave, B.A., of Magdalen College, Oxford, who had just become a Fellow of their Society. Mr. Neave had exhibited this form of the female *merope* together with *Planema poggei* as its model at both *soirées* of the Royal Society in May and June, a time when Mr. Trimen's absence from England unfortunately prevented him from seeing them. Mr. Neave had shown at the same time another most striking and interesting

member of the same group, a species of *Elymnias*, almost certainly a form of *E. phegea*, Fabr. He had formed the group in the course of an investigation into the bionomics of a very fine set of butterflies from the north-eastern shores of Lake Victoria Nyanza, presented to the Hope Department by Mr. C. A. Wiggins. Still later Mr. Wiggins had captured and presented further consignments, including a small but very interesting set of specimens from Entebbe. Among the later series, and especially that from Entebbe, Mr. Neave had found additional members of the same group:—another Acræine butterfly, viz. *A. aurivillii*, Staud., synaposematic with the principal model, *Planema poggei*; the *Pseudacræa*, exhibited by Mr. Trimen, *P. künowii*, Dewitz, var.; and a second probably undescribed species. All the above are obvious and strongly characterized members of the "*Planema poggei* group": a more outlying, but apparently distinct member was found in the female of *Precis rauana*, Grose-Smith.

October 21st, 1903.

The PRESIDENT, who also exhibited some forms of *M. aurinia* taken by Mr. A. H. Hamm at Basingstoke and elsewhere, and specimens of *M. athalia*, *M. didyma*, and *M. phœbe* from Asia Minor and Persia, continued the discussion, in which Mr. M. JACOBY and other Fellows joined.

The PRESIDENT inquired of any Fellow present whether it was the case that the dead leaves upon the ground in tropical countries tended to warp and curl in the dry season, but lay flat in the wet. He suggested that the remarkable tendency in the dry phases of many species of butterflies, with dead-leaf-like under-sides, to develop an elongated and hooked or bent apex to the fore-wing, and a greatly produced anal angle to the hind-wing, might thus receive its interpretation. The development certainly could not be explained by affinity, occurring as it did in the Nymphaline genera *Kallima* and *Precis*, the Satyrine genus *Melanitis*, and as Dr. Dixey has recently shown in the Pierine genus *Pyrisitia*.

The PRESIDENT further stated that Mr. H. C. Robinson had

informed him that it was certainly the case in northern Australia that the dry-season dead leaves were warped and the wet ones flattened.

In reply Mr. W. J. Kaye stated that he had been in Trinidad in the dry season, and noticed that the dead leaves were curled and bent, whereas in British Guiana which he visited in the wet season they were flat like damp blotting-paper.

November 4th, 1903.

The President exhibited a set of 323 butterflies from British Guiana, all captured on one day, August 28th, 1903, between the 9th and 10th mile from the Potaro River to the gold-mines. The road starts from the river-side at a point about 30 miles above the confluence with the Essequibo. This opportunity of studying the proportions of the various constituents of the Müllerian group was owing to the kindness of Mr. W. J. Kaye. The specimens constituted the entire catch of a single day, and all were taken by the road-side, on the white blossoms of a large-leaved plant which springs up wherever the bush is cut down. The catch represented a full day's work. August 28th was a particularly dry day in one of the driest months in the year. The butterflies were most plentiful from 6 to 11 a.m. and from 3 to 6 p.m., retiring into the thick bush during the hottest part of the day.

The dominance of the black-hind-winged group is seen in the fact that it included no less than 295 specimens belonging to the following species :—

Ithomiinæ.

Melinæa mneme—253. *Mechanitis polymnia*—9.
,, *crameri*—8. ,, n. sp.—10.
,, *egina*—9.

Danainæ.

Lycorea ceres—1.
,, *pasinuntia*—3.

*

HELICONINÆ.

Heliconius vetustus—1.
Eueides, n. sp.—1.

Thus a single species, *M. mneme*, entirely dominates the group. Beautiful series exhibiting transition from the barred to the black-hind-wing were seen in this species, and in the 3 individuals of *L. pasinuntia*. The single *L. ceres* was an intermediate example. One specimen of *Melinæa crameri* was broadly barred, and another faintly so. In Mr. Kaye's experience this species had hitherto always been black. *Mechanitis* n. sp. included a fine transitional series, but, as in other examples from this district, the black markings were very heavy even in the lightest forms. *Mechanitis polymnia* was, as usual, an antithesis to the last-named, the blackest hind wings being still distinctly barred.

Comparing these and other specimens in the Hope Department, and Mr. Kaye's fine series, with Oxford specimens of the same or representative species from Surinam, it appears certain that the Potaro district must stand on the fringe of the area where this black-hind-winged group is developing. The ancestral barred pattern and the various grades of intermediates which occur so abundantly with the black on the Potaro road are apparently far less common in Surinam, and are probably less common still in French Guiana. We do not, however, know the distance to which the group extends along the coast or into the interior. The apparent anomaly of the dominant *Melinæa mneme* exhibiting the most ancestral series of any species in the group may be merely a result of this position on the fringe of the area. Extended observations are greatly needed; for, so far as it is possible to judge from the facts before us, more could be learnt of the origin and more inferred as to the bionomic significance of this black-hind-winged group of the Guianas than any other in the world.

The remaining specimens, with the exception of a single Hesperiid, were all *Ithomiinæ*. They included 5 *Scada theaphia*, but no other member of its group; 1 *Ithomia zarepha*, but in this case also no other member of the group; 16 *ceratinia vallonia*, 1 *Napeogenes pheranthes*, another obvious member of

the same group, and 4 *ceratinia barii*, a more outlying member. The Hesperiid *Hesperia syrichthus* was the only butterfly out of the 323 which did not fall into one of the Ithomiine combinations.

November 18th, 1903.

Later in the discussion, replying to Mr. MORICE and Dr. CHAPMAN, the President said that during the past summer he had been experimenting on the eyes of the larvæ of *Ennomos autumnaria*. In the attempt to ascertain the physiological significance of the eyes, some of these larvæ had been blinded with a photographic varnish rendered opaque with lamp-black. It seemed impossible to imagine a more innocent material, and furthermore the application was but of short duration, for the varnish did not adhere well to the smooth chitin, and was soon rubbed off—probably an accidental result of the ordinary movements of the larvæ. Nevertheless, when the corresponding imagines emerged the speaker was intensely surprised to find that the majority of them were devoid of eyes, and that the antennæ were generally rudimentary. He could only suppose that something in the varnish, perhaps the spirit, penetrated pores in the chitin and injured the subjacent tissues.

The PRESIDENT showed an exhibit sent by Mr. A. H. Thayer, of Monadnock, N.H., U.S.A. The greyish silhouettes of two butterflies were represented in a tint nearly the same as the background, but sufficiently distinct to be easily recognizable. On one side of one silhouette a row of white spots had been placed in a submarginal position. It was evident that the adjacent border was thereby rendered far less distinct than that of the opposite side of the silhouette, or of both sides of the other silhouette. The spots in position and shape were approximately as in *Papilio polydamas*, and Mr. Thayer considered they possessed a similar significance in this butterfly. The dark ground-colour of many Rhopalocerous species he thought represented shadow under vegetation, the white submarginal lines and dots a generalization of flowers and flower-masses. But these markings also had a second meaning in that they tended to obliterate the tell-tale margin of the wings.

Professor POULTON also exhibited specimens of *Drurya antimachus*, together with the butterflies which he suggested as forming a group synaposematic with it. The central species appeared to be *Acræa egina*, round which clustered a number of other species of the same genus so much alike as to be probably indistinguishable upon the wing. Examples of these were exhibited, viz. *A. zetes*, *perenna*, *rogersi*, and *pharsalus*. Another beautiful Papilionine member of the group, *P. ridleyanus*, was also shown. Its pattern, in both sexes, was nearest to that of the male *A. egina*. In fact, so close was the resemblance that Godart had been entirely misled by it, and had described the *Papilio* under the name of *zidora* as the female of *Acræa egina*. Mr. Roland Trimen, F.R.S., had recently called the speaker's attention to this, and had informed him that the specimen of the *Papilio* in the Dufresne Collection at Edinburgh bears the MS. label "*zidora*, fem., *Egina*, Cram.," probably in Godart's handwriting. Godart's mistake had been recently pointed out by Mr. Percy H. Grimshaw, and Mr. Trimen had himself recognized it from Godart's description, and had made a note of it in his copy of the work.

An obvious Nymphaline member of the group was *Pseudacræa boisduvalii*, the male, like the last-named *Papilio*, resembling most closely the male of *Acræa egina*. It was the under-side of the female *Pseudacræa* which first suggested to the speaker the idea that *antimachus* was a member of the same group. While the upper-side of the *Papilio* seemed obviously mimetic of the male of *Acræa egina*, the under-side of its hind-wings possessed a remarkable and characteristic ochreous ground-colour distinguishing it from any other member of the group except the female *Pseudacræa*, in which a distinct resemblance was manifest. That the approach has been from the side of the latter seemed clear on comparing the female of the western form with that of its south-eastern close ally *Pseudacræa trimeni*, in which no rac of this peculiar tint was to be found. Such deutero-synaposematic resemblance between these two mimics of the *egina* type of colouring and pattern had been doubtless encouraged by the fact that they were the two largest members of the whole group, the female

Pseudacræa serving as a link between the immense *Papilio* and the comparatively small but dominant and central Acræine members. The inclusion of *antimachus,* in spite of its size, in this powerful combination seemed more satisfactory than Mr. Trimen's supposition in 1868 that it "is possibly an instance of special modification in imitation of some gigantic *Acræa* as yet unknown, or perhaps extinct" (Trans. Linn. Soc., vol. xxvi, 1870, p. 503). Professor Poulton suggested that it was possible that the remarkable bluish-grey patches on the underside of the fore-wing of *antimachus* were traces of descent from an ancestor common to it and the other equally extraordinary and equally isolated species of the genus *Drurya,—D. zalmoxis.*

In the discussion which followed the exhibit Professor Poulton suggested that the struggle for existence against the attacks of young, inexperienced enemies,—the kind of selective attack to which *ex hypothesi* Müllerian (synaposematic) resemblance was due—was in reality far more severe than appeared at first sight because of the pressure of the struggle upon the enemies themselves. This pressure was chiefly felt by the young, and it was so excessive that comparatively few individuals in the fresh wave sent forth at each breeding season, survived to become mature and experienced. It followed from this fact that the amount of selective pressure exerted by inexperienced enemies of insects was ten, twenty, a hundred, at any rate many times as great as that which was due to the educational period of the mature enemies existing at any moment.

With reference to the President's remarks, on the great size of *Drurya antimachus* compared to that of the other members of the synaposematic group, Mr. F. A. Heron suggested that, in the recognition of prey by sight, size,—within considerable limits,—might be of minor importance to coloration,—the term being used to cover every kind of pattern and marking. The size of an insect, as correlated with the idea of its distance, was, in natural surroundings, under varying atmospheric conditions, extremely difficult of exact estimation, though it might be easily observable in a group of other insects of known size in a standard cabinet drawer. Distance, and its correlative size, might perhaps be especially hard of determination by animals which, like the

majority of insect-hunting birds, had their eyes placed somewhat laterally and not frontally, as in the anthropoids in carnivora and in owls and similar predatory birds. For, unless the two eyes could be simultaneously focussed on the same object the estimation of distance, which determined the idea of size, could only take place by the knowledge of the effort made to secure the focus of one eye, instead of by the system of unconscious trigonometrical survey, which was one of the main sources of the knowledge of distance employed by frontal-eyed animals; unless, indeed, it were considered that the angle was measured first with one then with the other eye by quick movement of the head.

With monocular vision, where the distance was not exactly known, a small object nearer the beholder might subtend a greater angle than a larger similar one further off, and, if unfamiliar, be mistaken for the greater.

The idea of distance was one of the more slowly-acquired concepts; but the eyes of the young of all animals were quickly taken by conspicuous pattern.

Coloration, at one extreme, served to break up the apparent mass and protectively obscure it, while at the other it invited attention as some glaring label; a POISON label, which would denote danger to the consumer of the contents of the object bearing it, and, as in the case of the POISON label, the danger would exist irrespective of the size of the "label" and the object it protected. Perhaps it might not be too strong an assumption to consider that the young inexperienced enemy, tasting the gaudily-coloured, distasteful *Acræa*, would be impressed, more by the coloration—by the POISON label—than by the size of the object, and afterwards would avoid similary-coloured objects, which crossed its field of vision, without taking any conscious account of their size.

December 2nd, 1903.

The PRESIDENT exhibited a series of photographs sent by Mr. A. H. Thayer to illustrate his views on the significance of the colours and patterns of butterflies' wings. The insects had been photographed on masses of foliage and flowers, and it

was obvious that the dark ground-colour harmonized with the dark shadow behind and under the vegetation, while the light markings stood out as conventionalized representations of single flowers and flower-masses.

The PRESIDENT also exhibited the eyeless imagines and pupa-cases of *Ennomos autumnaria*, in illustration of his remarks at the meeting on November 18th. Imagines produced by unblinded larvæ were also shown for comparison.

EXTRACTS FROM THE PROCEEDINGS

OF THE

ENTOMOLOGICAL SOCIETY OF LONDON

(April 27th, 1904).

February 3rd, 1904.

The President exhibited a male and female of *Papilio dardanus*, captured *in coitu* by Mr. Geo. F. Leigh, at Durban in 1902, and examples of the offspring reared from the eggs laid by the female. The latter was of the *cenea* form, as were the great majority of the female offspring; three, however, were of the black and white *hippocoon* form. More recently, in 1903, Mr. Leigh had captured a female of the rare *trophonius* form, and had bred from the seven eggs laid by it five butterflies, of which the two females were both of the commonest *cenea* form. The female *trophonius* was also exhibited together with the five offspring.

March 2nd, 1904.

The President exhibited a specimen of *Glenea pulchella* (Thoms.), one of three individuals of the species taken on June 25th of last year, near "Barwood," in the Ouchterlong Valley, in the Nilgiris, by Mr. Leslie Andrewes. In a letter dated June 26th, 1903, not written with a view to publication, Mr. Andrewes described the circumstances of their capture: "The most striking [of the beetles] is a parti-coloured Longicorn about $1\frac{1}{4}$ inches long, which clearly mimics a large Ichneumon fly, which I have yet to discover. I have three of the beetles. The first two I was just going to grab as they settled, and each time I said to Downing, '. . . I'm glad I didn't catch that beastly fly: he looks like a stinger,' when something made me look again, and I saw what it was. It is curious my making the same mistake twice. It is a most elegant case of mimicry; yet when the beetle is in the

hand, it seems impossible to take it for anything but what it is. When it settles it curves the ends of its antennæ out and keeps them quivering just like an Ichneumon. There is a metallic sheen on the elytra just as you get on dark-winged flies, and the white spots on them seem to suggest an annulated body underneath the wings; yet the resemblance is not in the details of the markings, but in the whole appearance of the insect."

The PRESIDENT remarked that the appearance of the beetles entirely justified Mr. Andrewes' statement. No one, looking at the specimens in the cabinet, could imagine that during life they would suggest so strongly the appearance of a Hymenopterous insect. The allied species *G. iresine* (Pascoe), from Borneo, was described by Mr. R. W. C. Shelford, M.A., as a good mimic, and in this case the resemblance is tolerably obvious even in the dead specimen. Mr. Shelford says of it: "The middle third of the elytra is brown, shading anteriorly into blue, posteriorly into greyish-white; the model is a small blue *Hylotoma,* and when the wings are laid back the resemblance between the two species is striking; the blue anterior third of the beetle's elytra corresponds to the posterior part of the *Hylotoma's* thorax, the brown portion to the abdomen with the superposed wings, the greyish posterior third to the tips of the wings of the model, which project beyond the end of the abdomen." (Proc. Zool. Soc., 1902, vol. ii, p. 240.) When the whole genus *Glenea* is examined, the marked conspicuousness of some of the species suggests that the mimetic resemblance displayed by others is Müllerian or Synaposematic, rather than Batesian or Pseudaposematic. The essential importance of a study of the living insect in its normal environment, for the true interpretation of many examples of mimicry, could hardly receive a better illustration than by Mr. Andrewes' specimen accompanied by the notes upon it. Many years ago (in 1889) the speaker had shown a painting of the common English beetle, *Clytus arietis,* to Dr. Alfred R. Wallace, and suggested that it was a good example of mimetic resemblance to a wasp. Dr. Wallace was at first inclined to doubt this interpretation, but when asked whether he had ever seen the beetle move he recalled the habits of

the allied Oriental species and at once admitted the resemblance. The movements of the English species were described by the President in 1890 ("Colours of Animals," p. 250): "The slender wasp-like legs are moved in a rapid somewhat jerky manner, very different from the usual stolid Coleopterous stride, but remarkably like the active movements of a wasp, which always seem to imply the perfection of training."

Dr. F. A. Dixey read the following communication:

In the late Professor Westwood's "Introduction to the Modern Classification of Insects," vol. ii, 1840, p. 352, under the head of Heliconiidæ, there occurs the following passage: "A curious circumstance has been recently published relative to one of the species, *Euplœa* (*Danais*) *hamata*, MacLeay, an inhabitant of New Holland, where it abounds to such an extent, that it is employed as an article of food by the natives, who call them Bugong, and collect them by bushels, and then bake them by placing them upon heated ground." References are given by Westwood to Bennett's "Wanderings in New South Wales," and to Kirby's Bridgewater Treatise.

Thinking that the existence of a *Euplœa* (or, as it would now be called, a *Tirumala*) used as human food was a matter of considerable interest, I looked up the passage in Bennett's "Wanderings." It is as follows:

"The Bugong moths . . . collect on the surfaces and also in the crevices of the masses of granite in incredible quantities: to procure them with greater facility, the natives make smothered fires underneath those rocks about which they are collected, and suffocate them with smoke, at the same time sweeping them off frequently in bushels-full at a time. After they have collected a large quantity, they proceed to prepare them, which is done in the following manner. A circular space is cleared upon the ground, of a size proportioned to the number of insects to be prepared; on it a fire is lighted and kept burning until the ground is considered to be sufficiently heated, when, the fire being removed, and the ashes cleared away, the moths are placed upon the heated ground, and stirred about until the down and wings are removed from them; they are then placed on pieces of bark, and *winnowed* to separate the dust and wings mixed

with the bodies: they are then eaten, or placed in a wooden vessel called a 'Walbun,' or 'Culibun,' and pounded by a piece of wood into masses or cakes resembling lumps of fat, and may be compared in colour and consistence to dough made from smutty wheat mixed with fat. The bodies of the moths are large, and filled with a yellowish oil, resembling in taste a sweet nut. These masses . . . will not keep above a week, and seldom even for that time; but by smoking they are able to preserve them for a much longer period. The first time this diet is used by the native tribes, violent vomiting and other debilitating effects are produced; but after a few days they become accustomed to its use, and then thrive and fatten exceedingly upon it." ("Wanderings in New South Wales," by George Bennett. London, 1834. Vol. i, p. 270.) Mr. Bennett adds that "it is not only the native blacks that resort to the 'Bugong,' but crows also congregate for the same purpose." (*Ibid.*, p. 272.)

The foregoing extract contains several points of interest. In the first place the statement that the flavour of the insects resembles that of a sweet nut recalls the experience of Plateau with *Abraxas grossulariata*, and that of Wheeler and Marshall with various insects believed on good grounds to be objectionable to insect-eating animals. (See Prof. Poulton in Trans. Entom. Soc. Lond., 1902, pp. 405–414.) Again, the assertion as to the deleterious effects of the Bugong diet is of interest in relation to Prof. Poulton's suggestion regarding the rejection of *Acræas* by the *Mantidæ*, as being ultimately due to their unwholesome character. (*Ibid.*, pp. 318, 319.)

It will be observed that Mr. Bennett persistently speaks of the Bugong as a moth, whereas Prof. Westwood states categorically that it is a butterfly belonging to the genus *Euplœa*. The description of the insects "collecting in the crevices of the masses of granite in incredible quantities" seemed to me so unlike what was to be expected of a true *Euplœa*, that I could not help suspecting a mistake of some kind. Searching in Mr. Bennett's book for further information about the insect in question, I found the following description: "The largest specimen I obtained measured seven-eighths of an inch with the wings closed, the length

of the oily body being five-eighths of an inch, and of proportionate circumference; the expanded wings measured one inch and three-quarters across; the colour of the wings dark brown, with two black ocellated spots upon the upper ones; the body filled with yellow oil, and covered with down." . . . "On showing them [the Murrumbidgee natives] the few insects I had, they recognized them instantly; but I thought there was a feeling of disappointment at their curiosity only, not appetites, being gratified by my little entomological collection." (*Loc. cit.*, p. 274.)

It seems evident from this that Mr. Bennett is right in calling the Bugong a moth, and that it is at any rate certainly not a *Euplœa*. This fact robs the observation of some of its significance; nevertheless it seemed to be worth while to find out if possible the origin of the mistake. The explanation proved to be a simple one, but it affords so good an example of the way in which errors are propagated from book to book, that I think I may venture, without wearying my audience, to give a brief sketch of the history of this curious misapprehension.

On an earlier page of the "Wanderings," Mr. Bennett had been commenting on the gregarious habit of the Bugong, the purpose of which, he says, our present knowledge is insufficient to determine. To this passage he appends a footnote, which runs thus: "Captain Cook mentions, that at Thirsty Sound, on the coast of New South Wales, he found an incredible number of butterflies; so that, for the space of three or four acres, the air was so crowded with them, that millions were to be seen in every direction, at the same time that every branch and twig was covered with others that were not upon the wing; and Captain King observes ('Survey of the Coast of Australia,' vol. i, p. 195): 'Here, (Cape Cleveland,) as well as at every other place that we had landed upon within the tropic, the air is "crowded" with a species of butterfly, a great many of which were taken. It is, doubtless, the same species as that which Captain Cook remarks as so plentiful in Thirsty Sound. The numbers seen by us were indeed incredible; the stem of every grass tree, (Xanthorrhœa,) which plant grows abundantly upon the hills, was covered

with them; and on their taking wing, the air appeared, as it were, in perfect motion. It is a new species; and is described by my friend, Mr. W. S. MacLeay, under the name of *Euplœa hamata.*'" ("Wanderings," vol. i, p. 269.)

I have verified the quotation in King's "Survey," which was published in London in 1827. Cape Cleveland is in the present Colony of Queensland. In King's time it was in New South Wales, as shown in his map. MacLeay's description is in King's second volume, Appendix, p. 461. In the course of it he says, "This insect comes so very near to the *Euplœa limniace* of Godart and Cramer, which is common on the Coromandel Coast as well as in Java and Ceylon, that I can scarcely consider it as anything but a variety of that species."

From this it is clear that Captain King conjectures his *Euplœa* (i.e. *Tirumala*) to be the same species as that observed by Captain Cook, which may or may not be correct. Mr. Bennett, however, merely adduces their accounts as illustrations of the gregarious habit among lepidoptera, and in no sense attempts to identify these butterflies with his Bugong. But in the year following the publication of the "Wanderings," Mr. Kirby brought out his Bridgewater Treatise. In it he took occasion to reproduce from Mr. Bennett's book the account you have just heard, adding that "millions of these animals were observed also, on the coast of New Holland, both by Captains Cook and King." (Kirby, Bridgewater Treatise, London, 1835, vol. ii, p. 351.) Referring also to the Bugong, he speaks of "these moths, or rather butterflies," and appends a note giving their name as *Euplœa hamata*, MacLeay.

The original mistake was therefore the late Mr. Kirby's. He had evidently read Mr. Bennett's narrative, and the footnote giving the experiences of Captains Cook and King. From this he jumped to the conclusion that all three observers were speaking of the same insect—a conclusion from which a slightly more extended study of Mr. Bennett's work would have saved him. But having fallen into this error, he unfortunately carried Prof. Westwood with him, and one or other

of these authorities is probably responsible for the appearance of the same mistake in at least one work of popular natural history, where indeed it first attracted my attention.

The observation remains an interesting one, and I have thought it worth while, even at some risk of being tedious, to try to clear up the misapprehension that has surrounded it.

NOTE.—Sir George Hampson has kindly informed me that the true Bugong is probably *Euxoa infusa*, Boisd., one or two of the common allied species being very likely included under the same native name. *E. porphyricollis*, Guen., seems to suit Mr. Bennett's description fairly well. (See Sir G. Hampson's "Catalogue of the Lepidoptera Phalænæ in the British Museum," vol. iv, 1903, p. 165.)

Commander J. J. WALKER said the moth was an Agrotid (*Agrotis spina*) generally distributed over New South Wales and Victoria. It was perfectly true that the natives collected those insects for food. 1900 was a good *Bugon* year, but last November very few were met with. As to the nutritive qualities of the species, he said that the deck of H.M.S. "Ringarooma" in which he was at the time serving was much stained with oleaginous matter from crushed specimens which came aboard in great numbers.

Mr. C. O. WATERHOUSE said the specimens in the British Museum rather resembled *Mamestra brassicæ.*

Discussion.

The Rev. F. D. MORICE opened the discussion upon "What is a species?" He said that he had originally chosen this subject without knowing that it would be dealt with in the Presidential Address. That Address made it needless to touch on many points which must otherwise have been raised.

He did not think that the word "Species" need be or had better be dropped because we had generally abandoned the Linnean conception of a species. In all branches of science old words come to be used in new senses as knowledge advances and errors are exploded. We need not be too timid about the ghosts of old meanings. Astronomers still talk of "planets"; J. S. Mill re-defined Genera and Species in logic; and zoologists may claim a similar liberty.

The speaker thought that he personally meant by "a species" something like this—a group (the largest he could bring together) of forms so similar as to suggest descent from one ancestral pair of which they had retained practically all the heritable qualities: *i.e.* they differed only in such respects as we have reason to think either (*a*) individual and not phyletic (*aberrations, monstrosities*), or (*b*) phyletic but quite trifling in comparison with the conformity in other points (*races, sub-species*), or (*c*) resulting from a potential variability which was itself part of the original inheritance (*dimorphism, special adaptations*, etc.). He believed that "syngamy" would practically always characterize such a group, but that it was not the character which he himself had most in mind when considering whether a group was or was not a species. Nor did he think the absence of links with other groups essential to the definition.

Species seemed to him real but not permanent or ultimate phenomena in nature. At any time a transverse section through the "Tree of Life" (Darwin) would show us forms arranged at actual differing distances from one another, but no two such sections taken at different epochs would give the same result. What is now a species will one day be represented by a genus, or it may have passed out of existence altogether. The *Systema Naturæ* seems to conceive Science as mapping out and measuring a stationary field, we have come rather to regard her as having to deal with a flowing river.

Dr. F. A. Dixey said that though it was easy to define a "species" in the logical sense, the zoological conception of the term was surrounded by great difficulties. Darwin had explained what he meant by a species in contradistinction to a variety; but, as Professor Poulton pointed out in his Presidential Address, when asked for a definition by Phillips, Darwin had admitted his inability to give one. It was necessary to have a working unit for purposes of classification. Linnæus had supplied such a unit which had served its purpose for a time, but like other attempts it had eventually been found wanting in correspondence with the facts of nature. The present state of fluidity, however, was more hopeful than the old confusion out of which the Linnæan conception

emerged. It implied a recognition of the fact that hard-and-fast lines were not easily found in nature. Here and there an isolated assemblage of individuals could be named, round which it would be possible to draw a definite line; but in many cases the delimitation of frontier must be arbitrary. The President had brought forward a striking instance in the case of *Amauris niavius* and *A. dominicanus,* which had been shown by Mr. Neave to be connected in the Uganda district by a complete series of intermediate forms. Still more striking perhaps was the case of *Mylothris chloris* and *M. agathina,* which had always been considered as completely distinct as any two species in the genus, but which intergraded with one another in the same district of Uganda. In the genus *Colias* again, the speaker, after a careful study of Mr. Elwes' well-known papers, found himself in complete agreement with the opinions there expressed as to the impossibility of separating various forms that had received distinct specific names. "Typical" forms, for instance, of *C. palæno* and *C. chrysotheme* in the Old World, and of *C. philodice* and *C. eurytheme* in the New, were sufficiently dissimilar; yet in certain parts of their area of distribution, these forms seemed to be inextricably interconnected.

It appeared to be now admitted by many naturalists that the question, "What is a species?" resolved itself into a matter of general convenience. What then, from this point of view, were the best criteria of specific distinctness? The President in his recent Address had suggested more than one such test. Of these the most crucial was probably epigony. It met such cases as those of seasonal dimorphism, where the syngamic test was inapplicable; moreover it had the advantage of getting rid altogether of the arbitrary element. Evidence as to syngamy was extremely valuable, and in most cases was more easily obtained; but it could hardly be said that syngamy used as a test of specific distinction was able to dispense with the personal equation. Syngamy was controlled by sexual preference; of this many degrees were known to exist. On the one hand there was perfectly free interbreeding, on the other the "rare and occasional interbreeding" which, as Prof. Poulton said, "is not syngamy."

Somewhere among the intermediate stages the line must be drawn, and when drawn it would still be arbitrary.

On the question of sterility of first crosses and of hybrids, the President's criticism of the Knight-Darwin law seemed well-founded. Just as mutual fertility might be favoured under selection, so no doubt it might be diminished or abolished under isolation, by which selection is precluded. Sterility in such cases was thus rather a consequence than a cause. There must, however, be some reason for the numerous contrivances which existed to ensure cross-fertilization.

Mr. A. J. Chitty thought there were really two questions involved in the discussion. (1) Did there exist in nature anything corresponding to the one idea of species? (2) What was the point at which living things ought to be considered as distinct for the purposes of nomenclature and the arrangement of collections? In practice it was necessary to take some point, but if the history of life on the world was represented by a tree as explained by Mr. Morice, he doubted whether the idea of "species" had any counterpart in nature. The distinctions between animals would vary to an almost infinite extent, and would depend on the number of intermediate forms which had fallen out, and he doubted whether there was any precise point at which the distinctions became different in kind. For study and collecting purposes some such point must be chosen, but he was not prepared to lay down a rule where it should be placed. Where a large number of intermediate forms had fallen out you found a distinction which was what he understood was generally intended by the term "specific distinction." Where this was not so you got races and sub-species, and it was impossible that a collection should represent the actual state of things in nature.

Mr. H. J. Elwes, Mr. W. E. Sharp, Dr. T. A. Chapman, and other Fellows continued the discussion, and the President said that he did not think that he ought to speak on the subject after the amount of their time which he had occupied on the occasion of the Anniversary Address. He would like, however, to remark that he had never conceived of the origin of a species "from one ancestral pair," but always from the change of masses rather than of individuals. He heartily agreed with

Mr. Morice in regarding a genus as formed by the further differentiation of a single species, but it appeared to him that it was the splitting of the single community into separate sub-communities which was the foundation of the process. He quite agreed with Dr. Dixey that epigony was far superior to syngamy as a test of species, but he was considerably influenced by the much greater ease with which the latter evidence could be obtained in quantity. For one synepigonic family bred, the records of probably many hundred examples of pairing could be preserved. The former evidence is indeed hardly available at all for the travelling naturalist, while its collection on a large scale demanded the existence of the much-needed zoological station. Although, as Dr. Dixey had said, many degrees of syngamy were known to exist, it is improbable that the intermediate grades are sufficiently common to obscure the test, except in isolated cases. In conclusion the PRESIDENT said he had found much comfort in the reflection that after all the inter-breeding community is an objective fact, however difficult it may be to prove in any particular case, and that if this be accepted as a criterion of species it will be one in which the subjective element is reduced to a minimum.

March 16th, 1904.

Commander J. J. WALKER exhibited specimens of the "Bugong" Moth, *Agrotis spina*, Guenée, from Jervis Bay, N.S.W. (referred to at the previous meeting); and *Carthæa saturnoides*, Walk., a remarkable moth from Perth, W.A., now referred to the *Geometrina*, but possessing an extraordinary superficial resemblance to a *Saturniid* in aspect, though not to any one of the known Australian species of that family.

Colonel C. SWINHOE said the moth was a Monocteniid; and there was nothing in Australia which it could mimic.

[Mr. WALKER has since presented these specimens to the Hope Department.]

Dr. F. A. DIXEY exhibited a remarkable pale form of *Mamestra brassicæ*, taken by Dr. G. B. Longstaff and himself at Morthoe, North Devon, on July 16, 1903. The specimen

showed the usual markings of the species on a cream-coloured ground, faintly shot with pinkish or apricot. There was a slight smoky shade over the central area of the fore-wing, the hind-wings were yellowish-grey, the thorax yellowish-brown, the abdomen apricot-coloured with a dorsal chain of dark tufts. Mr. C. G. Barrett had examined the specimen, and pronounced it probably unique. Sir George Hampson had also seen it, and pointed out that it was provided with the spur on the anterior tibia, which is characteristic of *M. brassicæ* among the allied European species.

Papers, etc.

The PRESIDENT, Professor POULTON, read the following observations on the gregarious hibernation of certain Californian insects, communicated to him by Professor Vernon L. Kellog, of the Leland Stanford Junior University, California.

"In reading in Marshall and Poulton, Trans. Ent. Soc. Lond. 1902, your references to gregariousness in hibernating and migrating insects, I was reminded of two conspicuous examples of gregarious hibernation which we observe here every winter. The Monarch Butterfly, *Anosia plexippus,* gathers each winter in thousands in a small forest of pine trees on Point Pinos peninsula on the Bay of Monterey. Sometimes these butterflies will gather in a single tree in great clusters and festoons; other winters they will not be quite so compactly massed, but will be spread over a few acres of forest. The *Asclepias*, the food-plant of this insect, does not grow, at least in any abundance, on this peninsula, but does grow on another promontory about fifty miles north, and there I have found the larvæ and pupæ in great numbers.

"You are aware that our winter here is very mild; there are bright warm days all through it, and these butterflies do not by any means remain immovable during their hibernation. Flowers are blossoming all through the winter in the little village on Point Pinos, and the butterflies may be seen fluttering about at these flowers on any bright day in the winter. Nevertheless this is true hibernation and conspicuously gregarious in character. This butterfly is one which

Scudder and others have recorded as being migratory in the eastern States, moving in large flocks north and south with the varying seasons.

"The other case to which I refer is the gathering or 'sembling' of many thousands of the convergent lady-bird, *Hippodamia convergens*, on the ground under the fallen leaves in the deciduous forest of the low mountains near this University. We have taken as many as 40,000 of these beetles in a circular space of not more than ten feet radius. These beetles, when active, are found normally in the great orchards of the Santa Clara Valley, which lie at the foot of these mountains, feeding in the orchards on the scale insects and plant lice which are abundant there. But in winter the lady-birds leave the orchards, move up the mountain-side and hibernate as I have described. In fact, we are not acquainted with the full life history of this insect, not knowing how many generations appear in the year, or whether the mating is accomplished in the fall before hibernation, or in the spring after hibernation, so one cannot be sure that the case substantiates your suggested theory of gregarious hibernation as a means for quick mating in the spring.

"A third familiar example of 'sembling' to be noted in California is the gathering in great numbers of the butterfly, *Pyrameis cardui*, repeatedly observed in Southern California near Claremont village."

The PRESIDENT then read a short paper bearing on the same subject, entitled "A possible explanation of insect swarms on mountain-tops." The speaker said that he had been led to make this communication in consequence of Mr. G. C. Champion's exhibit at the last meeting of *Dorcadion* from Spanish mountain-tops. These specimens and the description of *Coccinellidæ* on the summits revived the speaker's memories of his visit to the Sierra Guadarrama in July 1902, and of the hypothesis which had suggested itself as an explanation of the similar and kindred phenomena which had come under his observation. On an isolated mass of rock near the summit of Peñalara (about 7700 feet), behind La Granja (San Ildefonso), he had found, on July 25, 1902, *Coccinella 7-punctata* under every stone, *Dorcadion hispanicum* crawling about every-

where, and *Ammophila hirsuta* flying in a swarm. The latter it will be remembered was found by Fabre in hundreds under a flat stone on the summit of Mont Ventoux, on a cold rainy day. Fabre had suggested that the insects were perhaps migrating from one district to another, and had paused to rest on the mountain-top; but the observation on Peñalara threw new light on the interpretation; for these Fossors as well as the *Dorcadion* were in a state of great activity in the bright sun and were pairing freely. Furthermore, both were in fresh condition and had evidently only recently emerged from the pupal state.

It was suggested as probable that certain species of insects with powerful flight, after reaching the imaginal state, have the instinct to seek conspicuous isolated features in the landscape, that in others with smaller powers or unable to fly the instinct is merely to ascend. The effect of both tendencies is to reduce the area over which the sexes have to find each other. A somewhat deferred maturity and the gradual collection of scattered individuals into swarms is probably associated with the instinct in many cases, facilitating still further the meeting of the sexes and the pairing of individuals from remote areas. It is obvious that the gathering swarm will be far more easily seen than single insects by the scattered individuals around. The swarming of beetles, etc., round tree-tops is probably to be thus explained. Related to the same combination of instincts preparatory to pairing is the driving off of the winged males and females by the workers of ant communities in response to some probably atmospheric stimulus which makes itself felt on a single day over a vast area. In the case of *Lasius niger* at El Escorial in July, 1902, the President had observed the workers driving off the males and females in separate waves, thus rendering it more probable that each would mature in the presence of the opposite sex from other formicaria rather than from their own.

In the discussion which followed on the tendency of insects to seek high and exposed places, Dr. T. A. Chapman suggested that whereas it is necessary that hybernation should be as complete as possible, hill-tops and similar situations would be affected as places where the cold would be continuous. Com-

mander WALKER said he had climbed to the top of Croagh Patrick, a very isolated mountain in County Mayo about 2500 feet high early in the year, and found a number of Coleoptera there as well as *Calocampa vetusta* hibernating. Mr. CHITTY drew attention to a paper on beetles recently published by the Director of the observatory on the summit of Ben Nevis, who attributed the presence of insects there to storms of wind. Mr. CHAMPION said that in the case of *Dorcadion* sp. on Moncayo in North Spain which he found running about there on the tops, as they were wingless, this could not be the cause of their presence, while he had found ladybirds under the snow. Colonel YERBURY mentioned the case of the Warble Fly, which will always fly up to elevated ground to pair, so that the plan recommended by Miss Ormerod and other economic entomologists of smearing the pastures with preventive mixtures was absurd, since the insect brings down its young with it, and does not breed in the low levels. Colonel SWINHOE supposed the swarming to be due to atmospheric conditions, and instanced the remarkable fact that all game will always fly up rather than down hill. Dr. DIXEY had observed great quantities of butterflies on an exposed and conspicuous ridge which ran out from the cliffs at Morthoe, N. Devon, chiefly Satyrids and "Blues," while Mr. ROWLAND-BROWN mentioned the many insects to be found at high alpine elevations, notably on the Besso (12,055 feet), near Zinal, where he had observed many small flies, and not far from the summit individuals of *Erebia glacialis*, attracted and drawn upward in his opinion by the warm upward currents of air from the valleys and lower slopes. Mr. TUTT supported the theory of insects seeking high and exposed localities for breeding purposes, and agreed with the view that hill-tops were the best places for assembling. Colonel BINGHAM, the Rev. F. D. MORICE, Mr. DONISTHORPE, and other Fellows joined in the discussion.

The PRESIDENT in reply thanked the Fellows for the many interesting facts which had been suggested bearing upon his hypothesis. With regard to *Dorcadion* he felt confident that the numbers on the conspicuous rock had not all been bred there, and that therefore there had been an instinct to crawl upwards from lower elevations. In this way, if the insects

only came from a few hundred feet below, their chances of meeting each other had been multiplied thousandfold. He quite agreed with Dr. Chapman that hybernation may have played an important part in the instinct in the case of the *Coccinellidæ* but not in that of *Dorcadion*, the *Ammophila*, or the swarms of ants.

EXTRACTS FROM THE PROCEEDINGS

OF THE

ENTOMOLOGICAL SOCIETY OF LONDON

(SEPT. 30TH, 1904).

May 4th.

Mr. G. H. VERRALL exhibited three specimens from the Hope Collection at Oxford of *Neoitamus cothurnatus*, Meig., an Asilid not previously recorded as British. They were taken near Oxford by Mr. W. Holland.

The PRESIDENT exhibited a Longicorn beetle captured near Malvern, Natal, by Mr. C. N. Barker, together with a large Bracon from the same locality. The following extract from one of Mr. Barker's letters indicates the close superficial resemblance which exists during movement between two insects which as cabinet specimens appear to bear no marked likeness to each other. "The large yellow and black ichneumon, when on the wing, bears an extraordinary likeness to the Longicorn *Nitocris nigricornis*, though no one would suspect a similarity in the cabinet. It is perhaps similarity of flight coupled with coloration that produces the effect, which has more than once deceived me."

The PRESIDENT said that his friend Professor E. A. Minchin of University College, London, had communicated the following observation of an attack made by a bird upon a species of *Elymnias*:—"Apropos of the footnote on p. 9 of your address at the Internat. Zool. Congr. at Berlin (1901), the following observation may interest you. It was made upon the common *Elymnias undularis*, at Aska in the Ganjam District of Madras, when I first went out, and this butterfly was then a novelty to me. As you doubtless know, the ♀ mimics *Danais chrysippus*, while the ♂ is totally different. It has rather skulking habits, keeps close in the shelter of the thickets, settles frequently, and seldom emerges into the

open. When it does it soon takes cover again. One day I was pursuing a ♂, and succeeded in driving it out from amongst the bushes into the open, and was running it down and was on the point of capturing it, when a bird swooped down and carried off the butterfly right in front of my net. I do not know the species of bird, but it was of small or moderate size. It is curious how many people deny that birds eat butterflies."

The PRESIDENT then read part of a letter recently received from Mr. J. C. Kershaw, one of the Fellows of the Society, living at Macao. The following observation throws much light upon the struggle for life endured by one species of butterfly at this locality:—"There is a cuckoo here (*Cuculus micropterus*) which certainly accounts for some species of butterfly being rare. Having shot several I found the stomachs crammed with what were obviously butterfly larvæ, some almost entire, and after a search found the same kind on a banyan. They were *Rhopalocampta benjamini*, a Skipper which I had always accounted very rare here, but of which I now have a good series. At intervals through the summer I shot these cuckoos, and always found them stuffed with caterpillars, mostly the larvæ of this large Skipper, which has a bright red and black head, unmistakable amongst the stomach contents, besides a few evidently only just swallowed."

A discussion on the bird enemies of lepidoptera followed, in which Mr. F. MERRIFIELD, Commander J. J. WALKER, Mr. M. BURR and other Fellows joined.

June 1st.

The PRESIDENT exhibited specimens of *Paltothyreus tarsatus*, Fabr., an ant belonging to the family *Poneridæ*, recently received from Dr. S. Schönland, Curator of the Albany Museum, Grahamstown. Colonel Bingham had kindly named the specimens and had pointed out that an allied species bears the name *Megaponera fœtens*, Fabr., indicating a similar power of emitting an offensive odour. Some of Dr. Schönland's specimens, which had come to this country in spirit, had been dried and mounted on cards. These, after the lapse

of a few days, still retained a very unpleasant smell. Dr. Schönland had sent the following statement on the subject :—

"On a recent trip (Sept. 1903) to the North-eastern Kalahari, we noticed on our first outspan, about eight miles west of Palapye Road Station, an awful stench, which, however, passed off after a time. It turned out afterwards that it emanated from some ants living in trees. We noticed them again at Serowe, Khama's capital, but unfortunately there was no opportunity then to make any detailed observations and we did not meet with them again, although I was told that they are not uncommon in Khama's country. Recently a friend of mine, Mr. S. Blackbeard, of Serowe, sent me some from Mapellapveda, about forty-five miles N.W. of Palapye Road Station, and I forward a few of them to you by this post. I have never come across any notice of them. Have you? They open up a wide field of biological enquiry. How do they produce the odour which comes near that awful stench of the well-known *Caralluma lutea* (an Asclepiad plant) found in the same neighbourhood? Can they let off their artillery at will? Do they use it as a means of defence, or, like their friend the Asclepiad, do they mean it to attract flies?"

The President exhibited a cluster of the green eggs of *Vanessa urticæ* fixed to the under-side of a small leaf towards the summit of a nettle-stem. The cryptic resemblance of the eggs to their environment was very remarkable. The eggs had been sent for exhibition to the Society by Mr. A. H. Hamm of the Hope Department, Oxford University Museum. The following observations upon the oviposition of a part of the exhibited egg-mass were recorded by Mr. Hamm :—

"While walking along the Shotover Road near Oxford on Sunday morning last (May 29), my attention was directed to a specimen of *Vanessa urticæ* which was sitting motionless with wings expanded horizontally on the upper-side of a small leaf near the top of a nettle-stem. On looking more closely I found that the butterfly was engaged in ovipositing, the abdomen being curved round the edge of the leaf so that the eggs were deposited upon the under surface. When first seen she had laid about half of the batch now exhibited. Although

the cluster does not present any approach to a regular form, the butterfly was apparently always very careful to feel with its ovipositor before extruding an egg: sometimes, indeed, she felt all over the mass before selecting a site. So engrossed was she in the work that when lightly stroked on the thorax she merely shut her wings with a snap and continued ovipositing. She was disturbed several times with the same result. The whole period of observation was fifteen minutes, during which about half the eggs were laid The insect laid the last egg at 11.20 a.m., and then flew away voluntarily.

"The eggs retained the bright green colour, which concealed them very effectively, until some time between 5.30 p.m. on June 7 and 7.45 a.m. on June 8. When examined at the hour last named they were found to possess a dark leaden colour, which was unchanged at 5 p.m. on the same day. At 7.40 a.m. on June 9, the young larvæ were distinctly visible through the transparent glassy shell, and by 2.40 p.m. they were hatching. The eggs, being laid in a heap, could not be counted, but a careful search on June 21 revealed the presence of 87 larvæ."

The PRESIDENT said that Mr. Hamm's interesting contribution to our knowledge of the life-history of this common species induced him to put on record the details of some observations of his own in 1900 upon the courtship and pairing of the same butterfly, so that both sets of notes might be published together:—

"On May 11 of the year 1900 I was fortunate enough to witness the courtship and pairing of a hybernated male and female of *Vanessa urticæ*. I was crossing a meadow of long grass bordering the river Cherwell just above the Oxford University Parks, when the butterflies flew past me, the male closely pursuing the female. The time was 3.45 p.m., and the sun was bright and warm. The insects flew low, just above the grass. The flight was rather slow and the direction winding, often bringing them over the same spot, so that although they alighted many times in the thirty minutes during which I watched them attentively, the observations were conducted on a spot of ground not more than a few yards square. Whenever they alighted the same attitude and the same relative

positions were maintained, both insects resting with outspread wings, the female immediately in front of the male. The head of the male was close to, and generally over the anal angle of one hind-wing of the female. So far as it was possible to follow them with the eye during their flight, the same relative position was maintained, the male following so closely that his head was probably often in contact with the hind-wing of the female. They alighted two or three times in the positions I have described, but were probably disturbed by my attempts to approach them. In a few minutes, however, they came to rest, and remained for about twenty minutes, during which I was able to observe them closely at a distance of about three feet. The male appeared to show excitement, especially in the earlier part of this period, in the frequent quivering of his wings, and occasionally in the much slower scratching movements of his second pair of legs. As far as I could see, these movements were not felt by the female and did not affect her. Of far greater interest was the movement of the head and antennæ, which evidently perform an epigamic function of considerable importance in this species. From the previous description of the relative positions it is clear that the antennæ as well as the head of the male overhang the hind-wings of the female. During the earlier part of this period the male's head was jerked repeatedly up and down, the knobs of the antennæ being of course moved through a large arc. At the same time I heard a succession of clicks distinctly synchronous with the jerks and evidently due to them. I have no doubt that the clicks were caused by the rapping of the male's head or the knobs of his antennæ upon the hind-wing of the female. The movements were extremely rapid and were many times repeated. The female remained apparently passive throughout the period, but three times she shut her wings up with a snap and remained in this attitude for a few seconds. At other times her wings were spread out flat, the anterior pair not being directed sufficiently far forward to bring their costal margins quite into line. The position of the wings of the male was not equally uniform, but they were always more or less outspread even when made to quiver. After about five minutes

from the beginning of this long period the signs of excitement became much less marked, while the rapping movements only took place occasionally. Finally the insects rose again and flew round in the same manner as before, similarly alighting two or three times for a few seconds. On one occasion, perhaps the first time after the long rest, they dived deeply into the grass, and I saw them fluttering together far down and almost hidden. They soon emerged, however, and finally alighting again, the male recommenced the rapping movements. On this occasion, however, the process was very brief, lasting for perhaps a quarter of a minute; they rose again and almost immediately darted into the long thick grass. Again I saw them fluttering far below the surface, but in a few seconds they had come to rest side by side on the underside of a buttercup-leaf. Coitus had already taken place, and the extremities of the two abdomens were bent round into a U. The wings of both were closed and were hanging downwards. The leaf on which they were resting was some inches below the top of the long grass. They were completely hidden and could only have been found by tracking them as I had done. They were now completely quiescent when the grass was disturbed in order to examine them more closely, when the buttercup-stem was picked, and even when I removed them, still side by side, between my finger and thumb. In this manner I carried them a few hundred yards and then took them home in a box and placed them in a cylinder with some green leaves, upon one of which they immediately took up a position similar to that which they had occupied on the buttercup-leaf. From 4.15 p.m., when coitus took place, they remained until 11.15 p.m., when I disturbed them in trying to ascertain whether pairing had come to end. Under ordinary circumstances it is improbable that they would have separated until the next day.

"In one respect the observation is incomplete. Courtship had already begun, and had been going on for an unknown period when the butterflies were first seen.

"In spite of this hiatus in our knowledge the observations here recorded throw much light on an obscure part of the natural history of this species. We now know by a direct

observation that pairing takes place between hybernated individuals in the spring—a conclusion which was long ago reached upon other grounds, as the following letters indicate.

"Mr. G. C. BARRETT wrote to me on the subject on May 14, 1900:—

'My experience on the point you mention is not large, and if you have definitely noticed the period of pairing of *Vanessa urticæ* it is of great interest. Of course I have seen the male pursuing the female in the sunny days of spring, and also have found it—both sexes, I believe—hybernating in August when but just from the pupa, but I cannot remember that I have seen actual pairing in this species—or in any *Vanessa* except *cardui*. On very hot days at the end of May and beginning of June worn females of this species may be seen flying in a wild manner, pursued closely by still more worn and tattered males; and *once* I saw them after this wild rushing about settle down on a branch of an oak-tree, and pairing at once took place. I *saw* the action of copulation, and left them paired on the tree.

'I think that all the species pair in the spring—I might even say that I do not think that the ♂ would live through the winter if *they had* paired! but this is merely opinion, though with good reason to back it.'

"Mr. J. W. TUTT wrote on May 15, 1900:—

'I have no notes upon the pairing of *Vanessa* except that on more than one occasion when *polychloros* has been abundant in the autumn and emerged early after a specially fine summer I have seen occasional pairs in the autumn. I suspect all such autumnal pairings are unusual, and that eggs are laid and the progeny exterminated. Still I have never seen any spring pairings, I think, of this species, and may be wrong. I believe I have seen *io* paired in spring.'

"Dr. CHAPMAN wrote on May 16, 1900:—

'You will see all I know on the point in E. M. M. for 1891, p. 22. I don't think I have seen a *Vanessa* in cop. But we know that males and females equally hybernate. I think it has over and over again been proved that female *Vanessa* are immature in autumn. I don't know that the same has been

shown for the male, but it probably is so. I have seen male *Vanessa* following up the females in spring, but I cannot refer you to any observation of my own (or any one else's) of the actual pairing.'

"One chief interest of these observations upon *V. urticæ* and of Mr. Barrett's upon *P. cardui* is the evident instinct to hide immediately before pairing and to remain hidden during the period of copulation. This instinct, which probably accounts for the deficiency in our knowledge on the subject, is readily explicable when we remember that the insects become motionless, unaffected by disturbance, and thus an easy prey to any of their enemies."

Mr. A. J. Chitty confirmed the President's observations. In April 1903, during the Easter holidays at Huntingfield, Kent, he watched a pair of *Vanessa urticæ* flying together in a part of a small wood where the trees were thin; the female settled on the ground and the male behind it with its head in the same direction. The male walked up from behind until it was almost touching it, and then commenced tapping the hind-wings of the female with its antennæ. During the time the insects were remarkably tame, and allowed him to stand quite near them. The female from time to time flew away and the male followed, and they settled again and repeated the performance. He watched them for about forty minutes, hoping to see them pair, but they eventually flew away to another part of the wood.

Dr. T. A. Chapman exhibited two very interesting Erebias caught by the President on the Guadarrama (near Madrid, Spain) on July 25th, 1902. These were the only two taken, although others were seen. The elevation at which they were met with was probably about 6000 feet. Though taken together and very much alike, they proved to be of two species, viz. *E. evias* and *E. stygne*, both males. Dr. Chapman remarked that they were the same two species which he found last year in Spain associated together and closely resembling each other, which is not their habit in Switzerland. Continuing he said: "Being single examples, we may fall into error, in assuming them to be typical of the forms of these species occurring in the Guadarrama, but no other course is open to us. The *Evias*

is much nearer the Swiss form than the Canales specimens, in having the third apical spot well-developed and the rust-colour but very slightly yellow, and is rather larger than the average of specimens from Canales. It is of the *Hispanica* form in having the rusty band broad towards the costa, and is *sui generis* in the band having its internal border very straight. No Canales specimen quite approaches it in this respect. No Canales specimen is quite as Swiss as this one in the development of the third spot.

"The straight internal border of the rusty band is as marked in the specimen of *Stygne*, and is here a much more remarkable and unusual variation. It resembles to an extreme degree on the upper-side *Neoridas* and *Goante* and differs from any *Stygne* I have ever seen. In other respects it is nearer Swiss *Stygne* than my var. *hispana*, being of smaller size and less strongly and brightly spotted. Each specimen taken alone is not so different from Mid-European forms as the Canales specimens, they differ in the same way and add the special feature of the straight inner border to the red band; and are thus quite as much like each other as the same species are at Canales. This seems to be a purely Spanish feature of these species, since Swiss examples do not resemble each other and rarely occur together. As regards *Evias*, the breadth of the band at costa is one character of var. *hispanica*, but I think the straightness of its inner margin is special and neither character has ever been noted in *Stygne*. The var. *bejarensis* of *Stygne*, otherwise so different, is very close to it in this respect.

"I have placed for comparison with them, (1) an average Swiss specimen of each, (2) the nearest to them that I can select from the Canales specimens, and (3) average Canales specimens of both species.

"As these specimens are both males, comparison of the females is not possible, but I put in also a Canales female of *Evias*, and three females of *Stygne*, a Swiss, a Canales and a Bejar specimen, to show how the latter (which is not associated with *Evias*) goes right away from the other forms male or female, but in the direction in which the others leave the Swiss form, viz. in greater size, brighter colour and larger markings.

"I put also a *Goante* ♂ for comparison with the *Stygne*, with which it is almost identical on the upper side.

"1. These specimens are, individually considered, less removed from Mid-European forms than the var. *Hispanica*.

"2. Nevertheless they approach each other at least quite as closely as the *Hispanica* do.

"3. They especially do this, by an alteration in the form of the rusty patch, which is unusual to either species and more like *Goante* or *Neoridas*.

"4. Since Guadarrama is further from Mid-Europe than Canales, var. *Hispanica* must be regarded as more local than necessarily Spanish.

"5. Perhaps the most important point is that though they do it by a somewhat different variation, they keep to the Spanish rôle of the two species of associating together and resembling each other, a feature very rare or unknown in Mid-Europe.

"If it is permissible to found named varieties on single specimens, I would suggest that they be called *peñalaræ*. *E. evias* var. *peñalaræ*, differs from var. *hispanica* in having all three apical ocelli equally developed, and the rusty band less yellow. I think it is very possible however that a further series would render it impossible to distinguish *Peñalaræ* from *Hispanica*. *E. stygne* var. *peñalaræ*. This does not resemble any named, or, so far as I am aware, known, variety in its most marked peculiarity, the straight inner margin of the rusty band. I should expect further specimens to agree in this and so make this *var.* a well-defined race."

The President communicated a paper by Mr. G. F. Leigh entitled "Synepigonic series of *Papilio cenea* (1902–3) and of *Hypolimnas misippus* (1904) together with observations on the life-history of the former" and exhibited specimens to illustrate the same.

Mr. Edward Saunders, F.R.S., F.L.S., communicated a paper on "Hymenoptera Aculeata from Majorca (1901) and Spain (1901–2)."

EXTRACTS FROM THE PROCEEDINGS

OF THE

ENTOMOLOGICAL SOCIETY OF LONDON

(JUNE 1ST—DECEMBER 7TH, 1904).

June 1st, 1904.

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Mr. EDWARD SAUNDERS, F.R.S., F.L.S., communicated a paper on "Hymenoptera Aculeata from Majorca (1901) and Spain (1901–2)."

Major NEVILLE MANDERS, R.A.M.C., F.Z.S., in his paper entitled "Some Breeding Experiments on *Catopsilia pyranthe*, and Notes on the Migration of Butterflies in Ceylon," began by observing that although the different forms of *C. pyranthe* in Ceylon certainly bore some relation to the seasons, they were all liable to occur all the year round. With the assistance of Mr. Wickwar he had ascertained that of sixty specimens captured during a migratory flight that took place in the hot, dry weather of February 1903, seventy-five per cent. were males, and sixty-four per cent. of the whole number were of the form more lightly spotted on the under-side; only four specimens, all females, bearing heavy markings in the same situation.

Several larvæ were collected at Colombo, nearly all in the same week, and were subjected to varying conditions of temperature and moisture. These conditions proved to be very destructive, only fifteen to twenty specimens coming to maturity out of quite two hundred larvæ. Most of the resulting emergences were represented in a photograph which was exhibited.

Dealing next with the question of migratory flights, Major

Manders calculated that during a swarm in October 1895, about 98,000 butterflies passed through a space sixty feet broad in twenty-eight hours. The course of these flights was shown by coloured lines drawn on a map of Ceylon [exhibited]; the butterflies concerned being, besides the *Catopsilias*, *Papilio jason*, *Appias paulina*, *A. albina*, *Euplœa asela*, *E. montana*, *Danais septentrionis* and *Kallima philarchus*.

The migrations of butterflies differed from those of locusts in the fact that instead of advancing in one compact body, like a human army, the butterflies, in whatever part of the island they happened to be hatched, began migrating immediately; so that on the same day the migration was as vigorous in one part of the island as in another. During the migratory flights in the wet season, the female *Catopsilias*, which at this time largely outnumbered the males, deposited their eggs so hastily and in such enormous numbers that few of the resulting larvæ could possibly come to maturity. The survivors would probably be mostly males, the larvæ of that sex being smaller and requiring less nourishment; this, in the author's opinion, accounting for the preponderance of the male sex in the dry-season flights. This periodical destruction from starvation of the female larvæ, and the consequent temporary predominance of males, might be regarded as a provision against the undue increase of the species.

Dr. F. A. Dixey remarked that though the results of Major Manders' experiments were numerically small, they were nevertheless of considerable interest. It appeared from the records of these experiments that the emergences all took place between the 5th and the 17th of December; and as the larvæ were collected in the same place and nearly at the same time, the butterflies might all be presumed to belong naturally to the same wet-season brood. It was remarkable that little or no difference was perceptible between the specimens kept at the ordinary temperature but in an atmosphere saturated with moisture, and those of which the larvæ were reared under normal conditions, and the pupæ had been iced. In both these cases the under-sides of the resulting butterflies tended to assume the macular appearance, the highest development of which was characteristic of the form generally called *gnoma*. It was also worthy of notice that the lowering of the temperature

in the latter case did not appear to have retarded the emergence. But the aspect of the third row of specimens—those which had been subjected to excessive dryness—was widely different from that of the rest. Here, as shown by Major Manders' photograph, the maculæ were almost entirely absent; and the butterflies, or at all events the females, were of the form usually known as *pyranthe*. In spite of the small numbers concerned, it could hardly be doubted that this difference was significant; and the main result appeared, therefore, to be that while neither moisture nor cooling produced any alteration in the appearance of the ordinary wet-season form, the exposure of larvæ belonging to the same form to an artificially dehydrated atmosphere did cause them to assume the garb that was generally characteristic of the dry months of the year. It was to be hoped that the experiments might be repeated with larger numbers. A point that seemed to require some explanation was that whereas the author of the present paper had no doubt that the specimens of *C. pyranthe* reared under conditions of drought were of the form that was commonest in the dry season, the late Mr. de Nicéville, on the other hand, spoke of the dry-season form as *C. gnoma*. It was perhaps possible that Mr. de Nicéville considered Fabricius's original description of *C. gnoma*, which mentions only one spot on the under-surface of the hind-wings, inapplicable to the heavily maculated phase recognized as *gnoma* by Moore (Lep. Ceylon, vol. i, 1880, p. 123), and by most other writers.

October 5th, 1904.

Dr. F. A. Dixey exhibited some preparations of the scent of male Pierine butterflies, and read the following note:—

"It has long been known that the male *Ganoris* (*Pieris*) *napi* emits a scent like that of lemon verbena. The fact is mentioned by Standfuss in his 'Handbuch,' and by Barrett in his 'British Lepidoptera.' The latter authority also remarks that the male of *Colias hyale* is said to have a smell like that of pineapple. In connection with work on the secondary sexual characters of the Pierines I have been attempting

for some time past to verify the statements that have been made on this head, and also to ascertain whether other species of our common butterflies likewise possess a characteristic odour.

"In the summer of 1899 I made the following observations:— A fresh specimen of *G. napi*, ♂, when seized with forceps, gave out a strong perfume very like the crushed leaf of a 'lemon plant.' The wings removed from the body retained the odour, which was also perceptible on the fingers when they had been used for rubbing the scales off the wing. A brush similarly used for removing the scales emitted the odour strongly. The body, though crushed, was odourless. A trial made with *G. brassicæ*, ♂, gave a negative result, but on subjecting a specimen of *G. rapæ*, ♂, to similar treatment, I fancied, but could not be absolutely certain, that a faint sweetish odour was perceptible.

"In the early autumn of 1900 I failed to detect any odour in a specimen of *Colias edusa*, ♂, which had been dead about twenty-four hours, but a few days later I repeated the trial with the following result:—A living *C. edusa*, ♂, was allowed to flutter about the room for a few minutes, then taken in the fingers and held gently. No odour was apparent, even when the so-called 'glands' on the costa of the hind-wing (which are well known to be absent in *C. hyale*) were uncovered. The 'glandular' patch of the right hind-wing was then carefully scraped with a penknife, and the little mass of scales thus detached was immediately smelt. There was a distinct sweetish and almost spicy odour which I should compare to heliotrope. It soon passed off, or I ceased to appreciate it. The patch on the left hind-wing was similarly scraped, with the same result, except that the odour seemed fainter. A trial was made with another specimen that had been dead at least twenty-four hours. As in the first case, I could not be sure that I detected the heliotrope odour. On crushing the thorax there appeared to be a slight scent somewhat like that of fresh varnish, and this seemed also to attach to the 'scent-scales' when scraped off the glandular patch. But it bore no resemblance to the perfume found in the living specimen. A few days later I convinced myself that the scales of the upper surface of the wings in *G. rapæ*, ♂, about which I had at first

been doubtful, really possessed a sweetish, fragrant odour, somewhat like that of mignonette. Two ladies, whom I had not told what to expect, also immediately detected a scent in the scales from the same upper surface, which they described, without prompting, as 'flowery' and like 'mignonette.' Neither of the ladies had the least doubt or hesitation about their verdict. In *G. rapæ*, ♀, similarly treated, we could find no trace of the odour. These observations were repeated three days later with fresh specimens, both male and female, and with the same result.

"In the course of last year (1903) I made several trials on common species in conjunction with Dr. Longstaff. Besides confirming previous results, we both detected a scent on the fore-wings of *Satyrus semele*, which to me seemed somewhat suggestive of chocolate. Dr. Longstaff has continued his observations both at home and abroad, and will, I hope, on some future occasion communicate his results to the Society. Last year I also obtained distinct evidence that the scent in *G. rapæ*, ♂, is confined to the scales of the upper surface. This perfume has been compared by Mr. Image to that of sweet-briar—which seems to me nearer the mark than my own suggestion of mignonette.

"During the present year I have been able to confirm Dr. Longstaff's opinion that *G. brassicæ*, ♂, possesses a characteristic odour. It is not easily appreciated, but when once caught is quite unmistakable. The best comparison I can make is with the petals of a scarlet geranium. I have again made trials with *S. semele*, ♂, whose scent has a slight pungency which I am now inclined to compare with that of sandalwood, though there is a delicate flower-like fragrance at the back of it. Trials were also made with *Pararge megæra*, ♂. The scent, as in the case of *S. semele*, appeared to be confined to the scales of the dark streak on the upper-side of the fore-wing. It was a faint, but heavy, sweet odour, suggestive of chocolate cream. It seemed to me to affect the back of the nose, even perhaps the pharynx, and to leave a kind of aroma which was enhanced by gentle expiration. *Lycæna icarus*, ♂, was found to have a faint scent also something like that of chocolate sweetmeats. This confirmed a previous observation by Dr. Longstaff. I am uncertain about *Epinephele janira*, ♂, but am inclined to think

that a slight odour is present. I find also a faint scent in the scales of the upper surface of *Gonepteryx rhamni*, ♂, which I cannot describe further than by calling it 'flowery.'

"There is, I think, absolutely no doubt that the scent of the male butterflies examined is associated with the special male scales, which are in some cases distributed more or less generally over the wing in the shape of the 'battledore scales' of Lycænids, and the 'plumules' of many Pierines, Satyrids and Nymphalids, and in other cases collected into the definite areas called variously 'chalky patches,' 'sex-brands' or 'glandular spots.' The proof of this is that scales removed from the wing are found to possess the odour strongly, provided that the special scales are present; the absence of special scales means the absence of scent. In *Colias edusa*, where the special scales are segregated, I obtained direct proof that the odour present in them was absent from the rest. The wings after being well rubbed retain little or no scent, nor does any appear to attach to the body. I reserve the case of *G. rhamni*, which has neither plumules nor circumscribed scent-patches, for later treatment.

"Though the special scent-scales seem to act as reservoirs and distributors of the perfume, they are not the seat of its manufacture. This is doubtless carried on by certain secreting cells, described and figured by Günther, which are found in connection with the sockets of the scent-scales, lying between the two layers of the wing-membrane. I have been investigating the structure of the scent-distributing apparatus in Pierines for some years past, and hope soon to be able to communicate my results, together with some account of the literature of the subject, which, though large, is scattered and by no means exhaustive.

"I may mention, in conclusion, that I have made several attempts to preserve the scent of various male butterflies, with more or less success. The first method I tried was extracting the wings with rectified spirit. This certainly took up the odour to some extent, but unless one uses the extract in a very concentrated form, the characteristic scent, which is seldom strong, is liable to be overpowered by the proper smell of the spirit. I then tried rubbing up the wings in a mortar with starch, choosing this as a practically odourless substance. In

this way I got enough material diffusing the pleasant lemon-verbena scent of *G. napi* to make a small sachet. Unfortunately, however, the scent in this form does not seem to be lasting; at any rate, I have not as yet been very successful in preventing its evanescence. It soon disappears, as might be expected, from butterflies being dried for the cabinet, though I have found it still strong in a specimen of *G. napi*, ♂, that had been eleven days in a cyanide bottle.

"I have here specimens of some of the common Pierine odours preserved in both ways—*G. brassicæ*, *G. rapæ* and *G. napi* in rectified spirit, *G. rapæ* and *G. napi* in starch powder. There are also, in similar bottles to the scents, samples of the spirit and starch used, in order to help in distinguishing any odour attaching to these substances from that due to the butterfly scales. I produce these specimens with some hesitation, because I am well aware that the perfumes are faint, and indeed are probably quite imperceptible to many people. That the bottles still retain sufficient odour to be easily discriminated by some persons, at any rate, I had proof this morning before bringing them here, and also this evening since entering the room."

Prof. R. MELDOLA, F.R.S., mentioned that he had already detected the scent of *Zanclognatha tarsipennalis*. The Rev. F. D. MORICE said the scent of some species of Hymenoptera was characteristic and well known. Mr. J. E. COLLIN said that some Diptera emitted a musky scent, and Col. BINGHAM instanced the case of certain Eastern *Euplœinæ*. Mr. J. W. TUTT, Mr. M. JACOBY, the PRESIDENT and other Fellows joined in the discussion.

October 19th, 1904.

Professor E. B. POULTON, F.R.S., exhibited a number of specimens of the genus *Sphecodes*, five species in all, and of their mimetic Tachinid fly, *Ocyptera brevicornis*, Loew, illustrating his remarks on Mr. Edward Saunders' paper on the Aculeate Hymenoptera from the Balearic Islands and Spain, published in the Transactions, 1904, pp. 644–649.

November 2nd, 1904.

The PRESIDENT exhibited a photograph taken by his assistant, Mr. A. H. Hamm of the Hope Department, Oxford, and communicated the following note, in which Mr. Hamm records his observation :—

"On the evening of the 8th of August last while looking over some Cactus Dahlias growing in my garden, I found a ♂ *Pieris rapæ* at rest on the petals of a pure white variety, and immediately photographed it *in situ*, as shown in the print exhibited.

"Again, on September 1st, in the evening, another ♂ of the same species was found at rest in an almost identical position on the same plant.

"And for the third time, on October 8th, yet another ♂ of *P. rapæ* was found at rest in a similar position on the same plant. The day succeeding October 8th was dull and chilly, and the butterfly remained without moving the whole day. In the evening of the 9th it was in exactly the same position as that occupied on the evening of the 8th.

"I had in all some thirty plants of Cactus Dahlias varying in colour from very dark purple-red to red, pink, mauve, orange and yellow ; but only two plants which were pure white. On no single occasion did I observe *P. rapæ* at rest on any other flower or plant than the one mentioned.

"This, I think, is very significant and emphasizes the fact that some insects do discriminate between colours in choosing a resting site, and that in the direction of protective resemblance. Otherwise why should *P. rapæ* on each occasion have chosen the white flower in preference to those of other colours in such close proximity ?"

Dr. T. A. CHAPMAN mentioned that he had once followed a specimen of *Colias edusa* for a considerable distance, and observed that it invariably came to rest upon a yellow leaf.

The PRESIDENT also exhibited four specimens of *Conorrhinus megistus*, Burm., a large South American Reduviid of a genus which is well known to attack man. These four examples were a few out of over three dozen brought back by W. J. Burchell, and the notes upon them are an interesting record

of his experience of the habits of the insect. All four were captured in the year 1828, and they bear labels as follows:—

(1) "22. 1. 28. This species I have generally found in my bedroom, and this individual in my bed."

(2) "26. 5. 28. In cubiculis et in lecto ipso."

(3) "II 4. 6. 28. In lecto. Its body filled with red blood, sucked from the human body as the common *Cimex lectularius.*"

(4) "14. 6. 28. *Percebéjo paulista.*"

All these labels except the second were written by Burchell in Brazil during his residence at Goyaz (Nov. 3, 1827 to Aug. 21, 1828). In the case of the second the original label had been replaced by another carefully written by Burchell after his return to England.

The fourth label suggests a local name, which, however, Burchell discredited in the following paragraph in his Brazilian note-book. It is to be observed that the note refers to a specimen taken three weeks later than No. (4). "1235. Cimex. The name *Percebêjo paulista,* if applicable to any, would be given to *C. lectularius,* but this name was a mere extempore invention by the person who gave it me. The present Cimex is here commonly called *Percebêjo cascúdo.*" The note is undated, but the date "4. 7. 28" accompanies No. "1235" on the specimen.

Don Fernando de Arteaga has kindly interpreted the Portuguese words. "Persevejo," as it should be spelt, means "bug," while "Paulista," apart from various meanings derived from St. Paul, bears, colloquially, the figurative significance of "obstinate" or "pig-headed." "Cascudo" means "with a thick shell," and figuratively "of a rough exterior." It is probable that the word is here used in the latter sense.

Burchell's specimens (2) and (3) are represented on p. 10.

Commander Walker has directed my attention to Darwin's account of another species of the same genus which he encountered only a few years later than Burchell, but in a very different part of the continent. This species, probably *C. infestans,* Klug., was spoken of as the Benchuca. Darwin's interesting record is as follows:—"At night [at Luxan, near Mendoza, Mch. 26, 1835] I experienced an attack (for it deserves no less a name) of the *Benchuca,* a species of

Reduvius, the great black bug of the Pampas. It is most disgusting to feel soft wingless insects [Darwin probably refers to the immature stages], about an inch long, crawling over one's body. Before sucking they are quite thin, but afterwards they become round and bloated with blood, and in this state are easily crushed. One which I caught at Iquique (for they are found in Chile and Peru,) was very empty. When placed on a table, and though surrounded by people, if a finger was presented, the bold insect would immediately

Natural size.

Two specimens of *Conorrhinus megistus*, Burm., together with the labels which accompany them.

protrude its sucker, make a charge, and, if allowed, draw blood. No pain was caused by the wound. It was curious to watch its body during the act of sucking, as in less than ten minutes it changed from being as flat as a wafer to a globular form. This one feast, for which the benchuca was indebted to one of the officers, kept it fat during four whole months; but, after the first fortnight, it was quite ready to have another suck." ("Journal of Researches, etc." London, 1876, p. 330.)

November 16th, 1904.

The PRESIDENT exhibited the Diptera of W. J. Burchell's British collection, and said that he was indebted to the kindness of Colonel J. W. Yerbury, Mr. G. H. Verrall, and Mr. J. E. Collin for the determinations. The chief interest of the collection lay in the large proportion of specimens taken in the garden of Churchfield House, Fulham; the great age of many examples, some dating back over 100 years; the remarkably full and precise data characteristic of this exact and keen observer; and the light thrown upon the movements of the great naturalist, who, after his return from Brazil in 1830, became one of the most isolated and mysterious figures in the roll of British science.

The PRESIDENT also exhibited seven skins of African caterpillars preserved by W. J. Burchell during his travels. They were as follows:—

(1) An unknown species of *Papilio* bearing the data "16.3.15. Pascitur in foliis *Umbelliferæ dendrophyllæ* affinis. v. H." Burchell was at "Nieúw Kloof Station" on March 16, 1815. "v. H." means "vide Herbarium." Burchell's Herbarium is now at Kew.

(2) The yellow and green form of *Acherontia atropos*, apparently full-fed. "22.12.14. Folia caulesque '*Solani tuberosi*' editur *Sphynx Atropos*? S. N." The last two letters refer to the "Systema Naturæ." The locality was "Krombeks-river Station."

(3) *Celerio lineata livornica*, probably nearly full-fed. The skin was kindly compared by Dr. Karl Jordan with specimens of this species in the Tring Museum. No data accompany this preparation.

(4) A green Chœrocampid larva. "28.11.14." The species cannot at present be determined. The locality was "Mountain Station."

(5) A brown Chœrocampid larva which Dr. Jordan thinks may be *Theretra cajus cajus*, Cram. "7.12.14." This and (4) are on one piece of paper and from the same locality. Both are probably nearly mature.

(6) An unknown Lasiocampid larva. "9.12.14. In mon-

tibus altis. *Restiones* varios, inter quos *R. giganteus*, edit. Penicillis in dorso lilacinis." This and (2) on the same piece of paper. Burchell was at "Mountain Station" on Dec. 19, 1814.

(7) An unknown larva which Dr. Jordan and Sir George Hampson believe to be a Lasiocampid. "20.10.14." The locality at this date was Mossel Bay.

All the above localities are in the south of Cape Colony between Mossel Bay and Cape Town, "Mountain Station" and "Krombeks-river Station" being to the N.E. of St. Sebastian's Bay. The former is in the Lange Berge, and Burchell determined its latitude as 33° 58′ 14″ S.

The method of preservation now so abundantly justified by the persistence of larval pattern and colouring for ninety years, is carefully described in "Travels in the Interior of Southern Africa" (vol. i, pp. 469—473. London, 1822). Burchell much wanted to preserve a large Puff Adder which had been killed near Klaarwater, on Nov. 19, 1811, by one of his Hottentots. In the absence of bottles, kegs, and spirits, "the idea was at last imagined of drying the skin, on the same principle, and in the same manner, as would have been done with a large leaf. . . . The whole process was extremely simple, and consisted merely in cutting it open, along the under part, entirely from the head to the point of the tail, and stripping off the skin, which was found to separate with the greatest facility. All the flesh was cut away as closely as possible to the head, which was left entire. The skin was then spread flat on a sheet of large strong paper, and placed between a number of other sheets to absorb the moisture. It was put into the press, leaving the head out so as not to be crushed, and kept there till perfectly dry; taking care every day, or every other day, to remove the sheets that had become damp, and replace them by an equal quantity of dry paper; but the skin itself was never separated from that sheet to which its inner side had adhered. . . . The skin requires no antiseptic preparation, nor any varnish to be applied to it! nor is any gum, or paste, at all necessary for making it adhere to the paper; a certain glutinous property of its own being sufficient for that purpose. . . . The paper used for this purpose was a strong white cartridge-paper,

. . . The most convenient mode of applying the skin to the paper, is by the assistance of a short roller, or cylinder, held in the hand, and on which the skin and paper are gradually rolled. By these means, only one part of the skin coming on to the paper at one time, the due stretching and placing of it is managed with the greater exactness: . . . I ought not in this place to omit mentioning, that, on an occasion, about a year later, when one of my Hottentots brought me a large *caterpillar*" [this may be No. 3, the specimen of *livornica*, without data], "the colours of which were exceedingly beautiful, and its delicate marks beyond the power of imitation, I was induced to try the experiment of preserving it in the manner I had adopted for the serpents. In this I met with exactly the same success; and which was afterwards fully confirmed by several other trials." [The six larvæ with data, Nos. 1, 2, and 4—7, are evidently referred to here.] "But as the time required for making a collection of these, must have been taken from other affairs of more importance, and as the possession of insects in the caterpillar state only, would have been of little use to science, and merely amusing curiosities, I collected very few objects of that kind. This hint may, perhaps, be the more valuable, as many difficulties have been found hitherto in the art of preserving the larvæ with their natural colours; a desideratum which this method will accomplish, if ten years be considered sufficient for proving their permanency."

December 7th, 1904

Mr. G. J. Arrow exhibited on behalf of the Hope Collection, and in illustration of his paper read Oct. 5 last, a series of specimens of Passalidæ collected by Burchell in Brazil, and read the following observations, found by Prof. Poulton among the MS. note-books of this traveller and referring to these specimens:—"1142. Passalus. Found under large chips of wood in the forest. In the manner of Carabi, but it does not run a fourth so quickly. Judging from large holes in these chips, its larvæ are bred there. On taking it in the hand, it

makes a faint [sound] between a hissing and a squeaking; like the Lamiæ." Dec. 9, 1826. At Rio das Pedras, Cubataõ. This is by far the earliest record of the possession by these beetles of vocal powers, the instruments of which have only recently been discovered by Mr. Babb of Massachusetts.

Mr. Arrow called attention to the remarkable fact that the six specimens exhibited, although apparently all found at the same time and place and supposed by Burchell to be of one species, actually consisted of no less than five species of three genera. Dissections were also shown illustrating the means by which the sound is produced in the Passalidæ.

Mr. Waterhouse further exhibited two Coleopterous larvæ from the Burchell Collection from Brazil, submitted to him for determination by Prof. Poulton. One was a Heteromerous larva (numbered 1154) two inches long, much resembling the larva of *Helops*. The more interesting one (numbered 1330) was noted by Burchell to be luminous. It was one inch in length, subcylindrical, and appeared to be the larva of an Elaterid, but the prothorax was unusually large, and the head retracted beneath; the mouth parts, although not those of a typical Elater, conformed more to that type than to any other with which he was acquainted.

In connection with Mr. Waterhouse's exhibits the President contributed the following notes:—"1154" is attached not only to the larva but also to the Anthribid *Ptychoderes elongatus*, Germ. The note is as follows:—"1154. Cut out of dead wood but not quite perfected. The long cylindric larva of this number was said to be cut from the same piece of wood and therefore may be the same insect." Dated Dec. 17, 1826. Locality, Cubatão; between the "Middle Part" (Dec. 16) and the "Upper Part of the ascent" (Dec. 22) of "the great range of mountains," the Sierra da Cubataõ.

"1330. Larva of (*Lampyris?*). Caught in the garden crawling on the ground at night, and detected by means of a small spot of light at the head; but on being touched it instantly emitted a much stronger light from every part or joint of the abdomen, which previously was quite dark. The light proceeded only from the under part: the back was dark

at all times." The date was March 1, 1829, and the locality Porto Real (now Porto Naçionale) on the River Tocantins. The observation is quoted in Ann. and Mag. Nat. Hist., 1904, xiii., p. 100, where, however, it is assumed that the larva, which had not then been found, was a Lampyrid. Burchell thought that the larva was probably that of "1334," a Lampyrid (taken on March 2, 1829) identified by Monsieur Jules Bourgeois as *Photuris lineola*, Blanch.

Commander J. J. Walker exhibited the type-specimen of *Haplothorax burchelli*, G. A. Waterhouse, from the Hope Collection, Oxford University Museum. This very remarkable Carabid was discovered by the celebrated South African traveller, W. J. Burchell, in St. Helena. It is now exceedingly rare in its sole locality, the late Mr. Wollaston, during his visit to the island in 1875–6, having entirely failed to find the beetle alive, though its dead and mutilated remains were often met with. Described Trans. Ent. Soc. III. p. 207, plate XII, f. 1.

The President exhibited cases showing the results of recent breeding experiments upon *Papilio cenea* conducted at Durban by Mr. G. F. Leigh, who had for the first time bred the form *trophonius* from *trophonius* itself. Mr. Leigh had watched a *trophonius* laying eggs, and, although he failed to catch the parent, a considerable number of eggs were obtained. These produced males, females of the *cenea* form, and a single *trophonius* female. A careful comparison of the whole synepigonic group would be presented to the Society at a later date. Adding this result to the records published in Mr. Leigh's paper in Part IV. of the Transactions (1904, p. 677), it will be found that the form *cenea* has produced *cenea* and a small proportion of *hippocoonoides*, while the form *trophonius* has produced *cenea* and a small proportion of *trophonius*. *Hippocoonoides* has not yet been bred from *trophonius*, nor has *trophonius* from *cenea*. *Hippocoonoides* has not been bred from at all. Much remains to be done, but Mr. Leigh's work marks a great advance in our knowledge of this most interesting of mimetic forms.

The President showed a long series of *Crastia amymone*, captured by Mr. J. C. Kershaw at Macao. The series exhibited a beautiful transition between typical *amymone*, Godt., and

godarti, Lucas, the lavender apical patch on the fore-wing first appearing as a minute trace in certain individuals, gradually becoming larger in others. Similar transition occurred in the development of the white marginal spots of the hind-wing. Mr. Heron had noticed intermediate forms between these two Euploeas about ten years ago, and had arranged them in the collection of the British Museum as possible hybrids between *godarti* and *felderi*, Butl. (= *amymone*). Among the three specimens thus arranged was one captured by Commander J. J. Walker in May, 1892. Mr. Kershaw's results throw new and unexpected light on the subject; for not only has he shown the gradual transition, but he has even succeeded more than once in breeding well-marked individuals of the one form from well-marked individuals of the other. He also states the larvæ eat the same food-plant, and are exactly alike, as also are the pupæ. After this evidence there can be no doubt that we are dealing with a single species, and *godarti* becomes a subspecific form of *amymone*. It is hoped that on some future occasion parent and offspring will be shown to the Society, and represented in one of the plates of the Transactions. The speaker expressed the opinion that Mr. Kershaw's observation was one of those important pieces of work which opened the way to a great deal more. He believed that there was no group in which such work is more wanted than in the Euploeina.

The President also exhibited a photograph, taken by Mr. Alfred Robinson of the Oxford University Museum, showing the Xylocopid model and its Asilid mimic exhibited by Mr. E. E. Green at the meeting of June 1 (Proc. Ent. Soc. Lond. 1904, p. xxxix). The example was particularly interesting, inasmuch as Mr. Green's record of the mimic circling round its model tended to support the view that the bee is the prey of the fly. (*See* Trans. Ent. Soc. Lond. 1904, pp. 661–663.) Mr. Robinson's photograph of model and mimic is reproduced on the following page.

Dr. G. B. Longstaff gave an account of his entomological experiences during a tour through India and Ceylon, October 10, 1903, to March 26, 1904. A main object had been to make bionomic observations on common butterflies. The specimens taken had been placed in the Hope Collection at Oxford.

He summarized the results of his observations, illustrating his remarks by exhibiting some of the insects referred to.

Omitting more doubtful cases, 32 specimens of 28 species exhibited what he took to be injuries inflicted by birds or lizards. Among them were two *Tirumala septentrionis* and two Papilios with conspicuous red warning marks, but no *Limnas*.

Three Satyrids, *Mycalesis indistans*, *Hipparchia parisatis*, and *Aulocera swaha*, had been observed to adopt a sideways attitude when at rest, especially when in full sunshine. He had moreover confirmed the like observation of E. H. A., "A Naturalist on the Prowl," in the case of *Melanitis ismene*. He stated that Dr. Dixey and he had observed a like habit

Xylocopa fenestrata, F. *Hyperechia xylocopiformis*, Walk.
(*Natural size.*)

in several English Satyrids, notably *Satyrus semele*. He pointed out that if the insect leaned towards the sun its shadow would be materially diminished, and it would be to that extent protected, since the shadow was often more conspicuous than the insect itself. He had some reason to believe that *Pararge shakra*, which sits upright, prefers to have its back to the sun, and so reduce its shadow to a mere line.

Many specimens had been examined during life to ascertain whether they had a scent perceptible to the human nose. In spite of the numerous difficulties he had come to certain conclusions.

He had confirmed Wood Mason's statement as to a jasmine-like scent in certain male *Catopsilias.*

A group of Pierines comprising *Ganoris rapæ*, *G. canidia*, *Huphina nerissa*, *Belenois mesentina*, *Catophaga paulina*, and *Delias eucharis*, all had a scent very suggestive of that of sweet-briar. It was probably confined to the male sex.

A smaller group of Pierines, comprising *Ganoris napi*, *G. oleracea*, and *G. melete*, had a strong and very characteristic scent reminding one of lemon-verbena. It was certainly confined to the male sex.

On the other hand, *Ganoris brassicæ* has a scent of its own, somewhat like violet-powder. Thus three species in one genus had distinct scents, but of these one was shared by many widely-spread genera. He believed that when more was known of these scents they might prove of considerable philogenetic value.

Several Danaids, viz. *Crastia core*, *C. asela*, *C. amymone* (at Macao), *Isamia midamus* (at Hong Kong), *Parantica ceylonica*, and *Chittira fumata*, all had a strong odour like acetylene.

Limnas chrysippus had a faint odour like cockroaches or musk-rats. He was unable to say whether these Danaine scents were confined to the male sex, although he believed it to be the case.

His observations on seasonal forms were to the effect that the forms of *Precis* agreed closely with wet and dry conditions, but this was not so in the case of either *Catopsilia pyranthe* or *Terias hecabe.*

He called attention to the fact that the anal lobe of certain Lycænids is set at right angles to the hind-wing; a fact usually lost in cabinet specimens by the results of setting. By specially set specimens and drawings taken from the living butterfly he showed that this structure, together with the tails, produced the appearance of a head and antennæ, and was probably protective.

In conclusion he showed by the lantern, photographs of some of the localities visited.

19

EXTRACTS FROM THE PROCEEDINGS

OF THE

ENTOMOLOGICAL SOCIETY OF LONDON

MARCH 1ST—JUNE 7TH, 1905.

Wednesday, March 1st, 1905.

Dr. F. A. DIXEY exhibited some cocoons and perfect insects of hybrid *Saturnias*, and made the following observations :—

"I ventured some time ago (see Proc. Ent. Soc. Lond., 1897, pp. l–liii) to draw attention to the experiments in hybridisation made by Dr. Standfuss, of Zürich, and to lay before the Entomological Society a brief summary of his principal results. In the year 1898 I published in 'Science Progress' a more extended account of Standfuss's work in this direction, giving particulars of several of the hybrid forms obtained by him, and adding comments of my own on what appeared to be their biological significance. This paper is included in vol. ii of the 'Hope Reports' (1901), and portions of it may be found, though (doubtless from inadvertence) without due acknowledgment, in the pages of an important work on Lepidoptera, now in course of publication. An excellent translation, by Mr. E. M. Dadd, of Dr. Standfuss's account of some later results than those recorded in his 'Handbuch' (Jena, 1896), was also published in the 'Entomologist' for 1900 and 1901. It is illustrated by four well-executed photographic plates.

"Dr. Standfuss has been good enough at various times to present me with some of his specimens; these are now, with two exceptions, in the Hope Collection at Oxford.

"The examples I exhibit to-night consist of hybrids of two kinds. The first is a pair, male and female, of the hybrid between *Saturnia pavonia*, Linn., ♂, and *S. pyri*, Schiff, ♀ (see 'Science Progress,' 1898, pp. 188, 189; pp. 4, 5 of the paper as included in the 'Hope Reports,' vol. ii, 1901). I have

added specimens of both sexes of the parent forms for comparison, and it will be seen that the cross-product (which Standfuss calls *S. emiliæ*) resembles a large *S. pavonia* rather than a small *S. pyri*; except that the sexual disparity in size and colour, which is so marked in *S. pavonia* as compared with *S. pyri*, is very little developed in the hybrid. In most of Standfuss's specimens of this hybrid, some of the veins are forked terminally. This it will be seen is the case with one vein of the right fore-wing in the male exhibited.

"The second form is a hybrid with a somewhat more complex ancestry. It consists of three males and three females of which the female parent is *S. pavonia*, and the male parent a hybrid between *S. pavonia*, ♂, and *S. spini*, Schiff, ♀, *i.e.* the cross-product to which Standfuss has given the name *S. bornemanni*. The present form (called by Standfuss *S. schaufussi*) is therefore, in the common way of reckoning, three-quarters *S. pavonia* and one-quarter *S. spini*. Dr. Standfuss's first attempt to rear it ended in failure, his specimens all dying in the larval stage. Subsequent trials, however, were more fortunate, and some examples of Standfuss's own rearing are figured in the 'Entomologist' for 1900, Pl. VII, figs. 6, 7, 8. The six individuals I now exhibit were reared from eggs kindly sent me by Dr. Standfuss in 1895, and are some of the actual specimens mentioned in the footnote on p. 189 (p. 5 in the 'Hope Reports') of the paper above referred to.

"Their history is briefly as follows:—

1895.

May 11. Eggs received from Dr. Standfuss.

„ 23. Eggs nearly all hatched. Larvæ black, hairy. Fed on whitethorn. Show distinctly gregarious habit.

June 3. Larvæ undergoing first moult. Some in second stage show a rather indistinct yellowish-brown lateral line. They are still gregarious.

„ 14. Larvæ in second moult. In third stage still black, but some have a yellow or orange lateral line.

June 24. Third moult. Larvæ in fourth stage are still black; hairs whitish. Front of head pale green; some show small portions of green colour on body.

„ 29. Eighteen larvæ in fourth stage given to Professor Poulton, for the Hope Department. Five others were afterwards given to another friend. The subsequent history refers only to six specimens finally retained by me.

July 5. Fourth moult. In fifth stage the ground-colour is generally black; a variable amount of green may be present in addition; in two out of the six the green predominates. Tubercles yellow, deepening to orange.

„ 20. First larva began to spin cocoon.

„ 21. Three larvæ now spinning. The cocoons are those marked 1969 in the exhibit. These three larvæ are black with orange tubercles, one is mottled with a little dull green. All the larvæ have throughout been variable, but especially so in the last stage, varying from bright green with black rings (like *S. pavonia*) to uniform black. Tubercles orange in all.

„ 24. A bright green larva with definite black rings, began to spin. This cocoon is the one marked 1443.

„ 27. Another larva, resembling the last, now spinning (cocoon numbered 1327). The last larva retained by me, a specimen with much less green ground-colour than the two just noted, also spinning to-day (cocoon 1273 in the exhibit).

"These larvæ all had a profuse diarrhœal discharge before spinning; the discharge was clear and colourless when emitted, afterwards becoming brown. A period of quiescence, lasting for twenty-four hours or thereabouts, intervened between the discharge and spinning. During this period the larvæ seemed shrunken and looked torpid and unhealthy. The cocoons were spun among twigs of the food-plant (whitethorn) with few or no leaves, in a glass cylinder resting on a white glazed plate.

They were all brown in colour, two (Nos. 1230 and 1327) being a little paler than the rest.

"The first emergence took place on March 17, 1896. It is the female numbered 1327 in the exhibit, and resulted from the bright green *pavonia*-like larva which spun on July 27, making a rather light-brown cocoon. Only one more of my six specimens reached the perfect state, and this did not appear until Dec. 1, 1896. It came from the bright green larva which spun a dark reddish-brown cocoon on July 24, 1895, and is the male numbered 1443. The other four specimens having shown no sign of emergence, I opened and examined the cocoons in April, 1898. Three of them (numbered 1969), all dark brown, each contained a dead larva. The fourth (the last one to be spun) was a somewhat pale-brown cocoon of a curious shape, having two orifices for emergence, only one of which was furnished with converging bristles (No. 1273). It contained the cast larval skin and a dead pupa.

"The four remaining examples of this hybrid now shown belong to that portion of the original batch which was consigned on June 29 to the Hope Department. They were reared with the rest, as I have related, up to the fourth larval stage. I have no record of the time of their emergence.

"It will be seen that in this form (*S. schaufussi*) there is far less difference between the sexes than in *S. pavonia.* In spite of the fact that only one grandparent is *S. spini*, the influence of this latter species is seen both in the reduction of the sexual disparity and also in the prevailing aspect of the larvæ in their last stage. The difference between the male (No. 1443) and those which emerged in the Hope Department is very noticeable. A similar variability in the males of the same hybrid was observed by Standfuss ('Entomologist,' 1900, p. 346, note; and Pl. VII, figs. 6, 7). I attribute the semitransparency of most of the specimens to the want of vigour characterising the batch generally, and showing itself in another way by the number of larvæ that failed to attain the perfect condition.

"While on the subject of *Saturnia* I may perhaps be allowed to mention that a passage in Mr. Tutt's very complete account

of the larva of *S. pavonia* ('British Lepidoptera,' vol. iii, pp. 325, 326) may give rise unintentionally to a false impression. The eighty larvæ there spoken of as having been received from Norfolk were reared by myself, and not, as might appear from Mr. Tutt's account, by Professor Poulton, who indeed to the best of my belief never saw them. I must therefore assume the entire responsibility for the description of their markings which Mr. Tutt quotes. In the succeeding year I raised a fresh brood, numbering 120, from two of the pink-tubercled larvæ of 1885, the parent imagines being still in my possession; 40 of these 1886 larvæ were reared and described by myself, and 80 were given by me to Professor Poulton, who also duly noted their appearance in the last stage, as recorded by Mr. Tutt. My original account will be found in Trans. Ent. Soc. Lond., 1887, pp. 310, 311, having been kindly incorporated by Professor Poulton, at my own request, with his 'Notes in 1886 upon Lepidopterous Larvæ.' On reference to this account it will be seen that Professor Poulton fully acknowledges the source of the description."

Professor E. B. POULTON, F.R.S., exhibited (1) Groups of Synaposematic Hymenoptera and Diptera captured by Mr. A. H. Hamm, of the Hope Department, Oxford University Museum, and (2) Three specimens of *Papilio hesperus*, taken at Entebbe in 1903, by Mr. C. A. Wiggins. The attention of the exhibitor had to be called by Mr. W. Holland, of the Hope Department, to the fact that the tails of the hind-wing had not been broken off in these excessively worn and torn specimens. The evidence supports the conclusion that the tails of a *Papilio*, if untouched by enemies, can endure a great deal of wear. (3) Professor POULTON also showed Nymphaline butterflies from Northern China, apparently mimetic of the male *Hypolimnas misippus*, which is not known to occur in this region.

Wednesday, March 15th, 1905.

Exhibitions.

Dr. F. A. DIXEY exhibited some butterflies from Natal which had been presented by Mr. G. A. K. Marshall, F.E.S., to the Hope Department at Oxford, and read the following note:—

*

"It will be remembered that some few years ago Mr. Marshall conducted certain experiments with a view to ascertain whether the assumption of the wet- or dry-season form of various African butterflies could be controlled by exposure in the pupal state to artificial conditions of temperature and moisture. Some of the results of these experiments were recorded and discussed by Mr. Marshall in Ann. Mag. Nat. Hist., 1901, vol. ii, p. 398. Others were dealt with in a paper published in Trans. Ent. Soc. Lond., 1902, p. 189. Most of the material produced in the course of this research was exhibited on the occasion when the last-named paper was read; the present specimens, however, though duly recorded in that paper, had not then reached the Hope Department. They were therefore not included in the comments added by me to Mr. Marshall's account of his experiments, and they have not previously been seen by the members of this Society. This note and exhibit may accordingly be taken as a kind of appendix to the paper in the 1902 volume of our Transactions.

"The specimens now shown are as follows:—

"(1) Four specimens of *Crenis boisduvalii*, Wallgrn.

"These form part of the series recorded by G. A. K. Marshall in Trans. Ent. Soc. Lond., 1902, p. 206. They consist of one ♂ reared under normal conditions; two ♀ ♀ exposed in the pupal condition to excessive moisture; and one ♀ similarly exposed to dry heat. They accord fairly with the seven specimens of the same series, reared under corresponding conditions, which were presented by Mr. Marshall to the Hope Collection in 1897. The statements made (*loc. cit.*, p. 209) with regard to the original seven are confirmed by the new accessions, with the exception that the upper surface of the male kept in normal surroundings is perhaps somewhat lighter than that of the dry-heat male already in the Collection. The under surface, however, of this male, and the general aspect of all the females support the conclusion before arrived at that the intermediate or early dry-season form of this butterfly can be at least slightly influenced in the direction of the dry- or wet-season phase respectively by artificial conditions of dry heat and moisture.

"(2) Three specimens of *Pinacopteryx pigea*, Boisd.

"These three males are the specimens referred to by Mr. Marshall (*loc. cit.*, pp. 206–208) as *d* of the first series, and *g*, *k* of the second series. Like the previous examples resulting from the same experiment, which are nine in number and all females, they tend to show that under conditions of moisture a certain approach is made towards the wet-season form of this species; this, however, is less conspicuous in the present group of males than in the females just referred to.

"(3) A male specimen of *Teracolus annæ*, Wallgrn.

"This specimen is spoken of by Mr. Marshall (*loc. cit.*, p. 201) as the one example which emerged out of two that were kept as pupæ for nine days in a damp jar. The present specimen shows a nearer approach to the full wet-season form than the example in the Hope Collection which was left under moist conditions for seven days instead of nine. It is, however, less 'wet' than another male bred at nearly the same time under normal conditions (*loc. cit.*, p. 202). In the case of this species the numbers experimented with are probably too small to warrant a definite conclusion as to its susceptibility.

"(4) A male specimen of *Teracolus auxo*, Luc.

"This very interesting butterfly is the last of the three individuals mentioned by Mr. Marshall (*loc. cit.*, p. 201) as having been bred from eggs laid by *Teracolus topha*, Wallgrn. The example previously presented to the Hope Collection is quite of the *auxo* form, though not extreme; but the present specimen, as noted by Mr. Marshall (*loc. cit.*), shows a still closer approach to the fullest *auxo* condition, which is known to be characteristic of the wet or summer season. The two specimens now referred to are of great value as having afforded the actual synepigonic proof of the specific identity of the two phases *T. auxo* and *T. topha*. This identity had been suspected so long ago as 1877 by Mansel Weale, who placed some of his specimens of these forms in the Hope Collection. But, as the writer has elsewhere stated, Mr. Marshall's experiments, the results of which are now at Oxford, remove the subject of the specific identity of these two forms from the region of probable conjecture to that of actual proof."

Wednesday, April 5th, 1905.

Dr. F. A. Dixey exhibited the social web and pupal shells of *Eucheira socialis*, Westw., together with specimens of the perfect insect, and made the following observations:—

"By the kindness of Professor Poulton I am able to show the common larval habitation of the remarkable gregarious Pierine *Eucheira socialis*, Westw. This is the actual nest, from Mexico, which was described and figured by Westwood in Trans. Ent. Soc. Lond., 1836, p. 38, and Pl. VI, figs. 1 and 2. The longitudinal incision is the one originally made by the late Hope Professor; the two transverse cuts have recently been added by myself, with the object of displaying the interior of the nest more clearly. The figure in our Transactions shows the upper part of the receptacle, and the twig which descends through its neck, thickly covered with the pupæ of the butterfly suspended by their tails—a most unusual mode of attachment among the Pierinæ, though not entirely unexampled. At some time in the period of over seventy years during which this specimen has been preserved, the dried pupæ have been attacked by some cabinet pest, as a result of which many have been detached from the wall of the nest, and several have crumbled away. Such of these loosened pupæ and their fragments as could be collected are now cemented to a card and shown beside the nest, while among the pupæ still *in situ* will be seen the little bosses of silk in which the anal hooks of the detached pupæ were once engaged.

"Similar nests, presumably of this species, have been described by many travellers. Westwood (*loc. cit.*) quotes from Hardy's 'Travels in the Interior of Mexico' one such account; and another, by A. Sallé, will be found in the 'Annales de la Société Entomologique de France,' 1857, p. 20. The latter observer, who discovered his nests on the branches of a small *Arbutus*, quotes from Humboldt, *Essai politique sur le royaume de la Nouvelle-Espagne*, Paris, 1827, p. 28, under the name of *Capullos de madrogno*, a description of nests which must, it seems, also have belonged to this species. Humboldt gives a short account of the larva, which, however, he considered to be a 'Bombyx.'

"In the year 1900, Dr. Dyar exhibited two of these nests, which had been sent to Washington by Dr. Alfredo Dugès, of Guanajuato, Mexico. Dr. Dyar at the same time showed specimens of the larva, of which he has published a minute description (Proc. Ent. Soc. Washington, vol. iv, 1901, pp. 419, 420). The food-plant was stated to be a species of *Arctostaphylos*. In the discussion which followed this exhibit, Dr. Dyar said that this was the only social butterfly known to him. It is no doubt rare in the extreme for the gregarious habit and the construction of a common abode to be carried so far in the case of butterflies as in the present example, but there is possibly at least one other instance to be found among the Pierines. I refer to *Neophasia terlootii*, Behr, which also inhabits Mexico and Arizona, and is stated by its describer to feed on an *Arbutus*, the larvæ forming common habitations in which they pupate gregariously. I cannot, however, avoid the suspicion that the nest of *Eucheira* has by some mistake been attributed to *Neophasia*, though the testimony of Behr with regard to *N. terlootii*, originally published in 1890 and repeated in a letter to Dr. Skinner in 1900, certainly appears to be explicit enough. This latter butterfly is especially interesting as possessing a female which closely resembles some of the mimetic forms of *Euterpe*. (See Proc. Calif. Acad. Sci., 2nd series, vol. ii, 1890, p. 91; Ent. News of Philadelphia, vol. xi, 1900, pp. 331, 413, 533, Pl. II, fig. 28, and Pl. XIV.) I am not aware that the method of pupal suspension in this species has been recorded, but the pupa of the other species of *Neophasia*, viz. *N. menapia*, Feld., is stated by H. Edwards to be invariably attached with the head upwards. (Proc. Calif. Acad. Sci., vol. v, 1875, p. 165.) Behr is of opinion that the two known species of *Neophasia* should be referred to the genus *Eucheira*; this, as I have elsewhere stated (Trans. Ent. Soc. Lond., 1904, p. 304), seems to rest on insufficient evidence, though there is doubtless some affinity between the two genera, and both belong to an early Pierine stock. When the life history of the primitive Pierines (*Metaporia*, *Pontia*, etc.) of Central Asia is better known, it will be interesting to see whether the social habit and community of larval shelter will be found to prevail with any of

these in a form at all comparable with those of their relatives on the other side of the Pacific. As I have before suggested (Trans. Ent. Soc. Lond., 1904, p. 303), it seems not at all unlikely that the common larval habitation of *Pontia* (*Aporia*) *cratægi*, rudimentary as it is, and belonging only to the early larval stages, may be a degenerate or undeveloped form of the elaborate silken nest constructed by the not very widely-removed *Eucheira socialis*."

Dr. W. J. HOLLAND, of Pittsburg, Pa., U.S.A., said that although he had been a Fellow of the Society for many years, this was the first meeting which he had ever attended, and he regarded it as a rather peculiar coincidence that the subject under discussion should be one from the study of which he himself had just freshly come. Continuing his remarks, Dr. HOLLAND said:—"In the early part of the past winter, the president of one of the Mexican railways showed me some pieces of a white silken web, remarkably tough and durable, which represented the covering of what he called 'a great cocoon,' abundant on the branches of the 'madroña' trees in the State of Durango, and always full of a multitude of caterpillars. I asked him to write at once to Mexico and request the superintendent of his railway to ship me a number of these silken bags. In due course of time I received a large crate filled with them, and, fortunately, when the bags arrived, the caterpillars having passed the final moult, some of them were already pupating, and I was able to watch the process. The butterflies subsequently emerged, and as I had imagined from the outset, the insect proved to be *Eucheira socialis*, Westw., the males appearing in advance of the females. Oviposition took place within the silken bags in a number of instances, the females not coming forth, and I noticed that a number of the females, which appeared to be sluggish in their movements, did not attain a perfect normal expansion of the wings, as if there were already a tendency toward the development of a weakly-winged or possibly an ultimate apterous form; a phenomenon which is well known in the case of the 'bag-moths.' This abortion of the wings, however, may have been purely an accident, but it was rather remarkable that while all the males emerged

with finally perfect wings—and there were some hundreds of them—a very heavy percentage of the females were either under-sized or partially aborted, crumpled, and unable to attain full development. Not having the proper food-plant, I was, of course, unable to work out the life history of the larvæ although I preserved a large number of them both in spirits and inflated. That this insect is congeneric with *Neophasia menapia* and *N. terlootii* I do not believe, and in this respect I quite agree with Dr. Dixey.

"In conclusion, it may be interesting to recall that my friend, Professor Carl Lumholz, in his recent book on Mexico, figures a group of Indians engaged in extracting the caterpillars from those silken tents. They are a staple article of diet among some of the mountain tribes, and I am told that the forests in places are literally white with the big silken webs, many of which are five or six times greater than the original specimen described and figured by Professor Westwood, and now before us.

"Meanwhile I have written a fully-illustrated article on the subject, which will shortly be published, covering my observations upon this interesting subject."

Professor E. B. Poulton, F.R.S., read the following note recently received from Mr. S. A. Neave, B.A., F.E.S. The observation supplies further interesting evidence of the superstitious dread of larvæ with terrifying eye-like markings (Trans. Ent. Soc. Lond. 1902, pp. 399–401):—

"Petauke, Fort Jameson,
N.E. Rhodesia.

"*January* 4–5, 1905. While here my boys brought me a specimen of Sphinx larva with terrifying markings. I think this must be the *Chœrocampa osiris* mentioned by Marshall (Trans. Ent. Soc. *vide supra*), but I have written a description of it in case it should prove to be different. I can add some further interesting evidence as to the value of its terrifying markings. It most successfully imposes upon the natives, who will not actually handle it at any price, and say they are afraid of its 'eyes.' I have asked I should think fifty natives and they all consider the ocellated spots to be eyes. They have

also a superstition that it jumps out of the bush and up a man's nostrils. This is all the more interesting when we remember that *all other* species of Sphinx larvæ that I have yet seen, besides many other Lepidopterous larvæ, are *eaten* by the natives and much searched for, being considered a great delicacy. They have different names for different species, which shows their great interest in them."

"*Jan.* 14. I have several of the *Chœrocampa* larvæ in captivity and three have just pupated. They spin a very slight web, with large meshes of tough silk around them. The natives were unaware of the metamorphoses of these larvæ and were very astonished to see the pupæ. They are inclined, I think, to attribute it to magic on my part!"

Mr. H. A. BYATT, B.A., read a paper on "*Pseudacræa poggei* and *Limnas chrysippus*; the Numerical Proportion of Mimic to Model."

Wednesday, May 3rd, 1905.

Commander J. J. WALKER exhibited (1) two specimens of the very rare Staphylinid, *Medon castaneus*, Grav., taken in the Oxford district during the last week of April 1905; (2) several examples of both sexes of the giant flea *Hystrichopsylla talpæ*, Curtis, from field-mouse nests in the same district; and (3) the type-specimen of the Bostrichid beetle *Dinoderus ocellaris*, Steph. (taken by the late Prof. Westwood at "Little Chelsea" previous to 1830), from the Hope Collection at Oxford.

With reference to the last exhibited he also contributed the following note:—

"*Dinoderus ocellaris*, Steph. (Ill. Mandib. III., p. 352, footnote [1830]), † Sp. 2, ocellaris. *Nigro-piceus, subnitidus, antennis pedibusque piceis, elytris punctatis, punctis ocellatis in striis digestis.* (Long. corp. 1½ lin.) Di? ocellaris *mihi*. Pitchy-black, slightly glossy; thorax tuberculate in front, punctate posteriorly; elytra rather deeply punctate, the punctures disposed in striæ, distinctly ocellated, and largest posteriorly; antennæ and legs piceous. I have little doubt of this insect being congenerous with the foregoing, but the

antennæ are broken. Taken at 'Little Chelsea' in July last. —Mr. Westwood. It is probably exotic, having been found in a cup of coffee."

"The British species" (of the family BOSTRICHIDÆ) "are few in number, of small size, and considerable rarity; indeed it is not improbable that some of them are not really indigenous, but have been imported in timber, etc., from abroad, as in the instance of *Dinoderus ocellaris,* described by Mr. Stephens, from my collection, which I found floating in a cup of coffee."—Westwood, Int. Mod. Classif. Insects, I., p. 278 (1839).

Professor E. B. POULTON, F.R.S., read the following note on "Heliotropism in *Pararge* and *Pyrameis,*" communicated by Dr. G. B. LONGSTAFF, M.D.:—"Following up my observations on the attitude at rest of *Pararge schakra,* Koll., made near Simla in October 1903,* I paid a good deal of attention in February and March of the present year to *P. meone,* Cram., a butterfly that I found in varying numbers in all the parts of Algeria that I visited. This is either a southern form of *P. ægeria,* L., or a closely allied species in which the yellowish spots are replaced by fulvous. It is fond of settling on sandy roads, rocks, walls, or the leaves of trees or shrubs, comparatively rarely visiting flowers. It first pitches, invariably I might say, with its wings about three-quarters expanded, and in the vast majority of cases with its back to the sun, the axis of the body being rarely more than 45° to either side; immediately after settling it more often than not adjusts itself, by a quick movement, so as to make its tail point fairly accurately to the sun. After this adjustment, if at all, it closes its wings over its back, and as a necessary result its shadow is reduced to, or approximates to, a mere line. There can, I think, be no doubt that this habit is a great protection to the insect, since when resting on fairly flat surfaces the shadow of a Satyrine or Nymphaline butterfly with cryptic under-side is often more conspicuous than the fly itself.

"I quote two cases from my notes:—

"Feb. 8, Guyotville. Watched a specimen settle about twenty times. The wings were always at first expanded about

* See Trans. Ent. Soc. Lond., 1905, p. 67 and 136.

three-fourths, an adjustment of its position was in most cases made immediately, and after that the wings were raised over the back. In about twelve cases the orientation was perfect and the shadow a minimum; in seven or eight cases the orientation was imperfect, with a maximum error of about 45°, but usually much less.

"Feb. 25, Biskra. Watched one settle three or four times, always with a shadow near the minimum.

"Only one specimen of *P. meone* was ever seen to settle *facing* the sun; it did so three times, a fourth time turning its tail in the usual way. This was at Biskra on March 5th, and I noted at the time that the sun was not shining strongly. Two only were observed to settle with the axis of the body at right angles to the sun. One of these appeared to be crippled in the legs, since it alone always sat on one side. A third specimen, feeding on laurustinus flower in the Chabet Gorge on March 18th, did not appear to orient itself by the sun.

"In conclusion, except early in the day, or when the sun is dull, or when feeding on flowers, *P. meone* settles with the axis of the body turned so that its tail points more or less accurately to the sun, therefore when the wings are raised, in the attitude of repose (as is more common towards the afternoon), the shadow is reduced to insignificant dimensions.

"*Pyrameis cardui*, L., is an abundant butterfly in Algeria. It is not so easy to watch as *P. meone*, for it is a strong flier and much more wary; moreover, many of the specimens were seen in exposed places during windy weather. Nevertheless, I can say confidently that it generally settles with its tail to the sun, though it does not do this with the regularity of *meone*. I saw two specimens turn their faces to the sun, and saw a third settle twice with its body axis at right angles, though the third time it settled normally. The first two freshly emerged specimens, at Hammam R'ihra, March 25th, did not orient as well as those that had hybernated.

"These observations confirm those of Professor G. H. Parker on *Vanessa antiopa*, L., and on a *Grapta* in the United States,* and supply a reason for the habit that does not appear to have occurred to him, namely, concealment when in repose."

* Referred to Trans. Ent. Soc. Lond., 1905, p. 136.

A discussion followed in which Dr. W. J. Holland said that he had not noticed this tendency to orientation. In the case of *Colias philodice* and other *Pieridæ*, he had observed that they assumed all manner of positions, so that it was not safe to extend the observation presented by Professor Poulton to such species. The President asked for information on the resting habit of *Selenia bilunaria*, and remarked that it differed in his observations from that of *S. tetralunaria* and the other members of the genus. Mr. C. O. Waterhouse remarked that he had noticed that butterflies always turn *to* the sun, so as to expose the greatest amount of surface to the warmth. Mr. G. C. Champion also mentioned that when collecting in the tropics he found that a dead butterfly exposed to the sun's rays at once shrivelled up. Mr. C. J. Gahan, Dr. F. A. Dixey, and other Fellows also joined in the discussion.

Wednesday, June 7th, 1905.

Professor E. B. Poulton, F.R.S., exhibited leaves of strawberry, *Berberis japonica*, and cherry-laurel which had been sent to him by Mr. W. B. Grove, of Handsworth, Birmingham. The leaves had been attacked by minute fungi which, in the strawberry and *Berberis*, had been identified by Prof. S. H. Vines, F.R.S., as *Phyllosticta fragaricola* and *Phyllosticta japonica*, respectively. The clean round holes in the laurel leaves had been caused by a fungus identified by Mr. George Massee as *Cercospora circumscissa*, Sacc.,—the "shot-hole fungus." The attack was local and followed by the death and disappearance of the central portion of the leaf-tissue of each patch, leaving a roundish or oval window outlined with brown, sometimes in the form of a narrow line, sometimes spreading peripherally into the leaf for a greater or less distance. In the strawberry the edges of the windows were somewhat ragged, but those of the other two leaves had smooth contours, and strikingly resembled the oval transparent areas upon the fore-wings of *Kallima inachis*, *paralekta*, etc.—surrounded most conspicuously with a marginal zone of modified colour varying greatly in different individuals as

regards both tint and breadth. Professor POULTON had believed that these "windows" of *Kallima* represented holes gnawed by larvæ and that the altered marginal zone reproduced the effect of the attacks of fungi entering along the freshly exposed tissues of the edge. But he now desired to withdraw his earlier hypothesis in favour of the more probable and convincing suggestion made by Mr. Grove. The origin of the suggestion is of some interest in relation to the meetings of their Society and other associations which promote the intercourse of naturalists. Professor POULTON in the course of the "Huxley Lecture," recently delivered by him in the University of Birmingham, had explained his hypothesis and illustrated it upon the screen. Mr. W. B. Grove heard the lecture and forthwith proceeded to develop a sounder hypothesis.

Professor POULTON also showed a photograph of the fungus-like marks on the wings of the Oriental Kallimas, prepared under his direction by Mr. Alfred Robinson of the Oxford University Museum. The photograph was taken with oblique illumination, and shows, somewhat magnified, the tall up-standing scales which form the centre of each well-marked patch, as well as the pronounced shadow cast by them. They doubtless represent, in form as well as in colour, the fructification in the centre of a patch of leaf-attacking fungus, perhaps the very kinds which at a later stage of their development produce the "windows" represented on another part of the wing-surface, perhaps some other common tropical Cryptogam.

Dr. G. B. LONGSTAFF read the following observations on scents in the male of *Gonepteryx*:—

"At Hammam Meskoutine, Algeria, on March 15th, 1905, while examining my captures towards the close of the day prior to writing the data on their envelopes, I was struck with the sweet scent of a ♂ *Gonepteryx cleopatra*, L. All the three dead specimens which I had taken that day had the scent, but in two it was faint. On March 19th, at Bougie, I confirmed this in a living specimen, describing the scent at the time as 'sweet, rich, thick—suggesting *Freesia*.' At Hammam R'ihra I submitted living ♂ *cleopatra* to four ladies; one could not detect the scent, another could not

describe it, a third compared it to primrose, the fourth compared it first to gorse, then to faint 'Syringa' (meaning *Philadelphus coronarius*). Personally after more experience I hesitate between *Freesia* and 'Syringa.' Altogether up to March 31st, when it was getting over, I examined nineteen male *G. cleopatra* and found the scent quite distinct in all save one.

"Though not as abundant in Algeria as *G. cleopatra*, our more familiar *G. rhamni*, L., is sufficiently common, and naturally I examined that species, or form, for scent. To my great surprise out of ten specimens examined not one had a scent at all like that of *cleopatra*, indeed in most of them I could detect no scent whatever! One day in the hotel garden at Hammam R'ihra, I caught within a space a few yards in extent, and within a quarter of an hour, five butterflies in the following order:—1 ♂ *rhamni*, 3 ♂ *cleopatra*, 1 ♂ *rhamni*; all the three *cleopatra* had the scent, but neither of the *rhamni*.

"The one specimen of *cleopatra* in which no scent was detected was tested on a day when my nasal mucous membrane was somewhat inflamed, moreover a neighbouring pig-stye was distinctly a disturbing element. For these reasons I do not include in the above numbers 2 ♂ *rhamni* examined under the same conditions with negative results.

"The living *Gonepteryx* can be easily held by the thumb below and the forefinger above the thorax, the wings being expanded, and so examined without appreciable injury to the specimen, in a way that the more delicate structure of most butterflies renders impossible.

"These surprising results struck me so much at the time that I took care to assure myself that I was not deceived, but I trust other entomologists will repeat the observations when opportunity offers. Such a difference in the scent of the two forms must imply a physiological difference that would point to a specific distinction.

"In North Devon on the 29th of last month I examined a ♂ *G. rhamni* but could detect no scent."

Dr. F. A. Dixey exhibited specimens of several forms of *Gonepteryx* occurring in the Palæarctic region, and commenting upon Dr. Longstaff's observations, said:—

"The facts relating to the scent of *Gonepteryx cleopatra*

and *G. rhamni* which have just been laid before us by Dr. Longstaff are of very great interest, and certainly point in the direction of a real distinction between the two forms. I have occasionally detected a slight scent in British specimens of *G. rhamni* ♂, as recorded in our 'Proceedings' for 1904, p. lviii, but nothing like what Dr. Longstaff describes in *G. cleopatra.*

"It is by no means easy to determine the relation in which the forms of the genus *Gonepteryx* stand to one another, and I hope I shall not be thought to be wasting the time of the meeting if I say a few words on this subject.

"In the Canary Islands we have *G. cleobule*, Hübn., which is no doubt a distinct insular form. The fore-wings in the male are of a brilliant orange right up to the margin, while the hind-wings of that sex and the whole upper-surface of the female are tinged with paler orange. In *G. maderensis*, Feld., from Madeira, the males more nearly resemble *G. cleopatra*, Linn., and the females are also more deeply coloured than in *G. rhamni. G. cleopatra*, as is well known, is chiefly characteristic of the Mediterranean subregion. Its male shows a brilliant orange flush on the fore-wings which varies somewhat in size, but is always, I think, inferior in area to that of *G. maderensis.* In Syria, Asia Minor, and the Island of Cyprus occurs the form *G. taurica*, Stdgr. (*G. antonia*, Butl.), which is like *G. cleopatra* with its orange flush in a pale, washed-out condition. *G. rhamni*, Linn., occurs generally in Europe, including the parts of the Mediterranean subregion inhabited by *G. cleopatra.* Mr. Elwes records it also from the Altai. In the Levant, and as far east as Turkestan (Elwes), is found a form, *G. farinosa*, Mann., in which the wings of both sexes have a mealy appearance, due to semi-erect scales like those which characterise the borders of the wings in many species of *Catopsilia* and *Callidryas. G. nipalensis*, G. R. Gray, of which *G. carnipennis*, Butl., is perhaps a dry-season phase, is the form inhabiting northern India and the Himalaya. The male is of a deeper and richer yellow than that of *G. rhamni*, and both sexes often have the orange discoidal spots, especially of the hind-wing, greatly increased in size. A similar form from China has an indication of an orange flush on the fore-wings in a still more attenuated form than *G. taurica.* This Chinese

form appears to be a seasonal phase of *G. acuminata*, Feld., which inhabits the same districts, together with Burma, and is marked by extreme angulation of the wings. *G. zaneka*, Moore, is a similar highly-angulated form from northern India. *G. aspasia*, Ménétr., is an *acuminata*-like type from Amurland, and a large race of *acuminata* from Japan has been named *G. maxima* by Butler.

"Additional data concerning the local and seasonal occurrence of these various forms are much needed. In the meantime certain points appear to be tolerably clear. Each of the forms *maxima, acuminata* and *aspasia* seems to occur under two phases; one distinguished by a lower degree of angulation and a comparatively smooth surface in the wings of both sexes, and by a richer and deeper yellow in the colouring of the males; the other having the fore-wings strongly uncinated, with the wings showing a mealy surface much like that of *G. farinosa*, and the colouring in the male generally paler. There appears to be some reason to suppose that these parallel phases in the three forms have a seasonal significance, and they were arranged by Mr. Butler in the National Collection in accordance with that view; the smooth-surfaced, deeply-coloured, less highly-angulated phase being considered to belong to the wet season, and the other to the dry. If this be so, it is interesting to observe that the same relation between dry season and uncination of the fore-wing obtains in the case of this genus as in the other instances from Pierine genera (*Pyrisitia proterpia* and *Teracolus auxo*) to which I drew attention in the volume of our Transactions for 1903, p. 157, and Plate VII, figs. 1–8. It is also significant in relation to the principle there laid down, that the most highly angulated forms to be met with in the genus are the supposed 'dry-season' females, especially, it may be noted, those of *G. acuminata*. Now whatever be the relation between the two 'seasonal' phases of the three forms just mentioned, I have little doubt that the same relation holds between *G. nipalensis* and *G. zaneka*; and I am quite prepared to find that these two are simply phases of the same species, the more markedly uncinate form *G. zaneka* belonging to the dry season, and the more deeply coloured form *G. nipalensis* to the wet.

"We have then, in passing from west to east, a chain of forms as follows:—*G. cleobule* (Canaries), *G. maderensis* (Madeira), *G. cleopatra* (Mediterranean), *G. taurica* (Levant), *G. nipalensis* and *G. zaneka* (N. India), *G. acuminata* (China and Burma), *G. aspasia* (E. Siberia), and *G. maxima* (Japan). These appear to stand to one another in the relation of more or less distinct geographical races; in some cases, as in that of *G. cleobule*, doubtless deserving the name of representative species. In passing from *G. cleobule* to *G. cleopatra* the orange flush diminishes in area but becomes heightened in colour; from *G. cleopatra* to *G. taurica* the area of the flush remains the same, but its intensity is lessened. In each of the forms ranging east of the habitat of *G. taurica* there are, as we have seen, two phases, perhaps seasonal in significance; one of which phases, resembling *G. cleopatra* more closely in contour, recalls it also by the reappearance, at least in the far eastern forms, of an indication of the orange flush.

"What, it may be asked, is the relation of *G. rhamni* to the other forms of the genus? If after studying the Asiatic forms in their 'seasonal' phases, we were suddenly confronted with *G. cleopatra* and *G. rhamni* for the first time, I believe we should be inclined to regard the two latter as also phases of each other, parallel with *G. nipalensis* and *G. zaneka*, or with the two forms of *G. acuminata*. But we know that whatever may be the relation between *G. rhamni* and *G. cleopatra*, it is not one of regular seasonal alternation. Are they to be regarded as completely distinct? If so, this would seem to carry with it a presumption that the supposed seasonal forms of *G. aspasia*, *G. maxima*, etc., have been wrongly associated; in which case the strongly acuminate, 'wet-season' forms, with *G. zaneka*, must be looked upon as geographical representatives of one species, viz., *G. rhamni*; and the less acuminate, 'dry-season' forms, with *G. nipalensis*, as the same of another species, viz., *G. cleopatra*. What evidence is there of a synepigonic kind? The statement met with in popular books, that *G. rhamni* and *G. cleopatra* have been reared from the same parent, appears to rest on a passage in Westwood's 'British Butterflies and their Transformations,' 1841, p. 13, in which he mentions

that M. Boisduval had informed him 'that he had reared *G. rhamni* and *G. cleopatra* from eggs deposited by the female of the former.' He adds a reference to Boisduval's Hist. Nat. Lepid., vol. i, p. 602, where, however, I find no statement about synepigony, though the author points out that the difference in shape which usually characterises *G. cleopatra* as compared with *G. rhamni* is not of constant occurrence. Specimens of *G. cleopatra* occasionally observed in Great Britain have doubtless been introduced; but Curtis's figure of *G. rhamni* with slight orange markings may probably represent a really British individual. On this part of the question, however, it will be allowed that Boisduval's alleged experience requires confirmation. As to syngamy, we have the interesting testimony of Mr. Bagwell-Purefoy ('Entomologist,' 1902, p. 304), who found that home-reared *G. rhamni* ♀, emerging in August, were persistently courted by *G. cleopatra* ♂, 'though whether any results were obtained is more than doubtful.' I would suggest that the reluctance of the female *G. rhamni* which Mr. Bagwell-Purefoy speaks of may have been due to the fact that this form, at any rate in the British Islands, does not pair until after hibernation.

"In favour of the view that *G. rhamni* and *G. cleopatra* are entirely distinct, we have the fact, explicitly stated by the last-named observer, that his *G. cleopatra* reared in Ireland under natural conditions were double-brooded, whereas *G. rhamni* is well known to be single-brooded, at least in a large part of its range. There is also the difference in contour, *G. rhamni* being much more acuminate than *G. cleopatra*. The food-plant, again, is said to be different. It would seem, however, that not one of these points is absolutely free from doubt. It is positively stated that *G. cleopatra* is single-brooded in some localities; and if it should turn out that, as has been asserted, *G. farinosa* is a second brood of *G. rhamni* in the eastern Mediterranean subregion, the supposed distinction would break down on both sides. Then with regard to contour, though the difference is usually well marked, it is possible, as Boisduval pointed out, to find specimens of *G. rhamni* which are less acuminate than some specimens of *G. cleopatra*. We often find females which belong unmistakably

to the *cleopatra* type, both in form and in colour; but beside these we get other females which in shape appear to be of the one form, and in colour of the other. Finally as to the food-plant. This in the case of *G. cleopatra* is said to be *Rhamnus alaternus* or *R. alpinus.* Mr. Bagwell-Purefoy's *cleopatra,* however, would not eat *R. alaternus*; but throve, like *rhamni,* on *R. catharticus.*

"Dr. Longstaff's very interesting observation must of course be allowed full weight. In reference to this it is remarkable that I have not found any scales in either *G. rhamni* or *G. cleopatra* which appear to be specialised for scent production; nor do I find any microscopic difference between the ordinary scales of these two forms, except in the matter of pigmentation. Further information as to all these forms would be very welcome, especially in the case of *G. farinosa* and its possible relation with *G. rhamni* and *G. taurica,* in company with the latter of which forms it was found flying by Mrs. Nicholl on the west side of Lebanon towards the end of June (Trans. Entom. Soc. Lond., 1901, p. 81). Meanwhile, I think it may be considered as open to question whether in a portion of their range *G. rhamni* and *G. cleopatra* may not to some extent intergrade, though for the most part they certainly appear to be distinct enough.

"By the kindness of Professor Poulton I am able to exhibit to-night specimens from the Hope Collection of many of the forms that have been mentioned in the course of these remarks."

EXTRACTS FROM THE PROCEEDINGS

OF THE

ENTOMOLOGICAL SOCIETY OF LONDON

(October 18th—December 6th, 1905).

Wednesday, October 18th, 1905.

Mr. R. Shelford showed several insects from Sarawak, Borneo, including (i) a Lygæid bug which had been taken burrowing in decayed wood: the fore-limbs exhibited a remarkable adaptation for fossorial habits, comparable with the modified fore-limbs of the mole-cricket (*Gryllotalpa*), which insect in Borneo is frequently found in decayed wood; (ii) a Brenthid beetle, with a deep channel running along the dorsal part of the prothorax, the lips of which channel are nearly apposed, so that the channel communicates with the exterior merely by a narrow slit, and constitutes a nearly cylindrical chamber; this chamber is occupied by Acari; (iii) two Brenthidæ with deeply sulcated prothorax, in which Acari occur; the sulci in these two species not being "roofed in" as in the preceding species: and (iv) an Anthribid beetle with a crescentic sulcus on the prothorax.

Wednesday, November 1st, 1905.

Dr. F. A. Dixey exhibited some specimens of African Pierine butterflies, together with alcoholic extracts of the wings of *Mylothris agathina*, Cram., ♂, and *Belenois severina*, Cram., ♂, and remarked upon them as follows:—

"It may be remembered that some little time since (see Proc. Ent. Soc. Lond., 1904, pp. lvi–lx) I gave a short account of various observations made by me in 1899, and subsequently, on the scents of several of our British butterflies, exhibiting at the same time preparations of some of these perfumes which

still retained their distinctive qualities. During the present year I have had the opportunity of testing many of the African butterflies in the same way, and I now propose to give details of some of the facts that I have been able to observe in relation to their property of scent-production. In this investigation I have had the great advantage of the co-operation of Dr. Longstaff, who had already, at my suggestion, made a careful examination of the odours of many Asiatic butterflies, as recorded in the volume of our Transactions for 1905, pp. 61–144. I am further indebted to him for permission to include his own impressions of these perfumes.

"The scents now dealt with are of two kinds; these may be roughly distinguished, in reference to their probable functional significance, as attractive and repulsive.

"The first class is, I think, of importance in courtship as a means of sexual attraction and possibly of recognition. The odours belonging to this class, in all the species with which I am here concerned, are confined to the male sex. They have a general family likeness, recalling in most cases the perfumes of flowers, or of various aromatic vegetable products such as lemon-peel, spices, vanilla and chocolate. They are, I think, in nearly every instance agreeable to the average human perception.

"The scents included in the second class are probably made use of for defensive purposes. They occur, as a rule, in species which we have grounds for believing to be distasteful to some at least of the usual enemies of butterflies. They are found, as would be expected on this supposition, in both sexes; and they are for the most part disagreeable or even disgusting to the human observer. It is perhaps conceivable that both kinds of odours may occur in the same individual; though such instances, if they exist at all, would appear to be rare.

"The Pierine scents that have been examined belong to the first class—probably serving the purpose of sexual attraction and perhaps also of recognition. I subjoin a list of the African species in which they have been noted.

"*Catopsilia florella*, Fabr. When the tufts of hair-like scales present in the male are exposed by separating the fore- from the hind-wing, they emit a very strong, sweet

scent, which Dr. Longstaff compares to that of 'tuberose' or *Freesia*, and to my mind suggests jasmine. (A similar scent was detected by Wood-Mason in the Indian *C. gnoma* [*pyranthe*]. See Journal of the Asiatic Society of Bengal, vol. lv., Part II, 1886, No. 4, p. 371.)

"*Colias electra*, Linn. The wings of a male specimen were separated, and the costal patches of the hind-wing smelt, with a negative result. The left costal patch was then scraped with a penknife and the detached scales tested, again with a negative result. The right costal patch was then gently scraped and the patch itself smelt. I immediately perceived a distinct flowery fragrance reminding me of heliotrope, with the added suggestion of chocolate. The scent, which was quite pleasant, corresponded very fairly with my recollection of that of *Colias edusa*, Fabr., obtained in a similar manner (Proc. Ent. Soc. Lond., 1904, p. lvii). In the latter case, however, I was able to detect the odour in the detached scales.

"In two males similarly examined by Dr. Longstaff, the scent, although sweet, contained a disagreeable element which led him to compare it to that of 'bad sweetmeats.' This was not the case with the specimen above recorded by me, though I can confirm the observation with regard to one of Dr. Longstaff's males.

"Two specimens of *Teracolus achine*, Cram., ♂, emitted a distinct flowery perfume, something like that of honeysuckle. Another seemed to be devoid of odour; the female also was found to be scentless.

"The scent of *Teracolus annæ*, Wallgrn., ♂, is faint, but quite unmistakably present in some individuals. It is flowery, with a slight roughness or spiciness suggestive of heliotrope. Dr. Longstaff failed to detect a scent in one of his specimens, but found it very faintly present in a second. He is inclined to compare it with that of *G. rapæ*.

"In *Teracolus auxo*, Luc., ♂, the fragrance may be strong, in which case it resembles that of some heavily-scented white flowers such as 'Syringa' (*Philadelphus*) or jasmine. There is no suggestion of either lemon or rose—both of these being odours not uncommonly met with among Pierines.

Dr. Longstaff, who found the scent faint (as I did in some instances), characterizes it as 'clean, flowery'; and compares it with that of *Ganoris brassicæ*, Linn.

"*Teracolus eris*, Klug, was only encountered in small numbers. A male caught by me on the banks of the Zambesi had a distinct flowery scent when fresh. A corresponding observation was made by Dr. Longstaff.

"In *Teracolus omphale*, Godt., ♂, I was invariably able to detect an odour, always well-marked and often strong. This odour in the first place resembled that of *T. auxo* in its likeness to the fragrance of *Philadelphus*; a possibly nearer comparison, however, being with the white lily. But in addition to this 'white-flower perfume' there was nearly always present an aromatic, almost 'snuffy' constituent of different character, hard to define; this gave to the scent a certain roughness—not, as in *G. rapæ*, the roughness of sweetbriar—and suggested at one time chocolate, at another musk, while itself quite distinct from either. Two females of this species were found to be completely devoid of odour. Dr. Longstaff's results with *T. omphale* ♂ were largely negative. In three specimens, however, he found a fairly strong scent which he compares to that of *Freesia* or honeysuckle.

"The scent in *Teracolus ione*, Godt., ♂, cannot always be detected. When present, it is sweet, flowery, and apparently free from all traces of 'snuffiness.'

"*Eronia cleodora*, Hübn., ♂. In this form the intensity of the odour varies greatly; the scent is sometimes absent altogether, but when present may be strong. Its basis is a flowery perfume like that found in many species of *Teracolus*, but to this is superadded an aromatic element giving a distinct suggestion of sweet chocolate. Dr. Longstaff, who found the scent very faint in all his specimens, considers it to belong to the *G. brassicæ* type.

"*Belenois gidica*, Godt., ♂, appears in many instances to be without perceptible odour. Occasionally, however, I found it to possess an odour of roses, which in one of my specimens was strong. Dr. Longstaff's results were mainly negative, but in a few instances he reports a slight, sweet flowery perfume.

"A specimen of *Belenois mesentina*, Cram., ♂, emitted, when

fresh, a scent much like that of *B. gidica.* In a second specimen no odour was detected.

"*Belenois severina*, Cram., ♂ shows, like *Eronia cleodora*, much individual variation in the matter of scent. An odour is, however, nearly always present in greater or less intensity, and to my mind is of the same general character as that of *G. rapæ*, giving a decided suggestion of sweetbriar. Dr. Longstaff, who also finds great individual differences in intensity, considers the scent to be 'like that of *G. brassicæ*, but stronger and more luscious.' I have tested the female, with negative results.

"*Belenois thysa*, Hopff., ♂, has a strong, distinct odour, which appears to me to be like that of roses. Dr. Longstaff notes it as a very sweet scent; in one case comparing it to that of *Scilla nutans*, in other cases to that of *Freesia*.

"The scent of *Belenois zochalia*, Boisd., ♂, is not as a rule very powerful. It seems to me to be of the sweetbriar order, including the scent of the flower as well as of the foliage. It was more distinct in a worn specimen than in two fresh ones examined on the same day. Dr. Longstaff found a 'faint flowery scent like that of *G. brassicæ*' in the single individual he tested.

"*Pinacopteryx charina*, Boisd., ♂, has a perfume like a whiff of mignonette, seldom strong and often absent. Of nine males tested at different times by Dr. Longstaff, only one had a decided odour, which he records simply as 'flowery.'

"In *Pinacopteryx pigea*, Boisd., ♂, the scent is distinct, in some cases strong. It appears to me to resemble honeysuckle —a comparison in which Dr. Longstaff concurs. One of my specimens had an odour more suggestive of *Philadelphus*, and the scent of one of Dr. Longstaff's was noted by him as 'sweet and spicy.' The female was found by me to be odourless.

"The scent of *Mylothris agathina*, Cram., ♂, though varying somewhat in intensity in different individuals, is generally one of the strongest and most distinct in the whole range of Pierine odours so far as I am acquainted with them. To both Dr. Longstaff and myself it appears to be exactly that of sweetbriar. It is a pleasant and refreshing perfume, and is easily perceptible even when the butterfly is held in the hand

unrubbed. The female was always found by me to be scentless; but one tested, after death, by Dr. Longstaff, had a strong 'mousy' odour, like henbane; an observation which I can confirm.

"The scent of *Mylothris rüppellii*, ♂, is in the opinion of both of us indistinguishable from that of *M. agathina*, ♂. A female specimen, when dead, was noted by Dr. Longstaff as having a slight 'black-beetle' odour; this, however, I failed to detect.

"In nearly all the specimens of *Mylothris trimenia*, Butl., ♂, which I was able to test, there was a strong, pleasant, characteristic odour, not easily described, and quite distinct from that of *M. agathina*. It contains a predominating sweet flowery constituent, perhaps a little like that of *Pinacopteryx pigea*, but reminding me rather of sweet-pea than of honeysuckle. Besides this there seems to be an element of sweetbriar, but without the characteristic roughness—recalling rather the rose than the foliage of that plant. The scent also conveys a suspicion of orange or lemon-peel—nearer orange. The scent of nearly all Dr. Longstaff's specimens was noted by him as being like that of clover; in one, however, it was thought to be like that of *G. rapæ*. The female was found by me to be scentless.

"Only one specimen of *Glutophrissa saba*, Fabr., ♂, was tested; no odour was detected.

"A few specimens of *Synchloë hellica*, Linn., ♂, examined by me gave a distinct, though not very strong scent like that of gorse. The females were odourless, as indeed were many of the males. A male tested by Dr. Longstaff was recorded by him as having 'a very slight, heavy, flowery odour.'

"It is worthy of notice that although in all these species the intensity of the scent varies, sometimes greatly, as between different individuals, this variation bears no definite relation to the condition as to freshness of the specimen examined. I have no clear evidence that the scent is discharged more copiously during courtship; though this may quite possibly be the case. The perfume may persist for some little while after the death of the insect, but has generally become much impaired or has disappeared altogether by the time that the

butterfly is stiff. So long as stiffening has not taken place, the scent is more easily detected and estimated at home than in the field. Rubbing the wings is in most cases unnecessary.

"I exhibit this evening spirit extracts of the wings of *Mylothris agathina* and *Belenois severina*, which will be found easily distinguishable by the sense of smell from each other and from the pure spirit. On a future occasion I hope to say something of the odours as they exist in other groups of butterflies."

A discussion on the presence and use of scents in various orders of insects followed, in which the President, Professor Poulton, Col. C. T. Bingham, and other Fellows joined.

Wednesday, November 15th, 1905.

Dr. F. A. Dixey exhibited some specimens of African Pierinæ, and remarked upon them as follows:—

"The recent visit paid by Dr. Longstaff and myself to South Africa fell, so far as Natal and Rhodesia are concerned, well within the limits of the dry season. I have brought here for exhibition representative specimens of four species of *Teracolus*, viz., *T. annæ*, Wallgrn., *T. omphale*, Godt., *T. achine*, Cram., and *T. auxo*, Luc., all taken by us in those localities during August and September of the present year. Wherever possible, I have included the male and female of both the Natal and the Rhodesian form of each species exhibited. I also show, for comparison, male and female specimens of the same four species, taken in the same localities as our own, but during the wet season of the year instead of the dry. As none of the specimens exhibited was selected for the purpose of proving any point, but each is a fair representative of the category to which it belongs, the whole assemblage may be taken as an illustration of the general correspondence of the variation of these particular forms with the meteorological conditions prevailing at the time of year when they are respectively found. So different in appearance

re the 'wet season' and 'dry season' phases of these butterflies, that, as has also happened in many other cases, they have been described under different names, and are even now pretty generally ranked as separate species. It may therefore not be amiss to recall the fact that in the case of three out of the four it has been absolutely proved by Mr. G. A. K. Marshall, who has bred them through, that the two seasonal forms are conspecific (see Trans. Ent. Soc. Lond., 1902, pp. 200, 209–212).

"There remain two further points that seem worthy of note. One is that, as will be easily evident on inspection, our Natal forms, though distinctly of the 'dry season' type, are appreciably less extreme in that direction than are our Rhodesian representatives of the same species. This corresponds with the much more markedly dry meteorological conditions that we found prevailing in the latter locality. The other point is that, even in cases where the wet-season males of two species, such as *T. omphale* and *T. achine*, are quite unlike one another, the resemblance between the dry-season males of the same two species may be so close that in the field they can only be distinguished with difficulty."

Colonel J. W. Yerbury said that in his opinion the term "seasonal" when applied to developments of this kind was misleading. The variation of the forms seemed to depend not upon fixed seasonal conditions, wet or dry weather, but upon the amount of moisture and light to which the species were subjected, probably in the pupal stage.

Professor E. B. Poulton understood that the term "season" as used in this connection, referred to the climatic conditions which prevailed at the time. He considered that "wet form" and "dry form" were more accurate expressions than "wet season form" and "dry season form."

Wednesday, December 6th, 1905.

Dr. F. A. Dixey exhibited examples of five species of South African Pierinæ, in further illustration of geographical and seasonal variation. The exhibit, which was supplementary to

that shown on November 15, comprised specimens of *Eronia cleodora*, Hübn., from East London and Natal, *Belenois severina*, Cram., from Natal and Rhodesia, *Teracolus speciosus*, Wallgrn., *Pinacopteryx pigea*, Boisd., and *P. charina*, Boisd., all from Natal. In every instance the contrast between forms captured during the dry months of the year and specimens of the same species taken in the same localities during the rains was very distinct. Two points were mentioned as being especially worthy of note. The first was the extremely "dry" character of the examples of *E. cleodora* taken both in August and September at East London as compared with those taken in August at Durban. The difference was so well marked and so constant as to suggest the existence in the region south-west of Natal of a distinct local race. The second point was the appearance presented by the "dry season" examples of *B. severina* from Rhodesia, in which the dark veining of the under-side of the hind-wing tended to become faint or to disappear; this disappearance of the veining being in Natal specimens a mark of the "wet season" phase of the species, while the "dry season" forms from Durban were in nearly every instance heavily veined beneath. Dr. Dixey further remarked that the seasonal relations of the various forms of *B. severina* had always been somewhat of a puzzle, and the difficulty seemed to be increased rather than diminished by a consideration of the present specimens. More data were needed in regard both to this species and to the nearly-allied *B. mesentina*, before any satisfactory conclusion could be reached. With regard to the exhibit as a whole, he was well aware that by selecting instances it was often possible to make out a better case than the facts really warranted. He had, however, done his best, in arranging the present series, to choose not extreme, but average representatives of each form of the various species exhibited.

Mr. R. Shelford exhibited the larvæ of *Collyris emarginatus*, Dej., and of *Mormolyce*, and read the following notes:—"In 'Mededeelingen uit 'Slands Plantentuin,' xliv, 1901, p. 113, Dr. J. C. Koningsberger, of the Buitenzorg Zoological Museum, publishes a brief notice of the larva of the Cicindelid beetle, *Collyris emarginatus*, Dej., burrowing in the twigs of

coffee-shrubs. I noticed a preparation illustrating this remarkable habit for a Cicindelid larva in the museum at Buitenzorg in March of this year, but it was inside a locked case, and as Dr. Koningsberger was on leave in Europe, I was unable to make a close examination of the larva and its burrow. In answer to a request for material and information on the species, Dr. Koningsberger has kindly sent me the specimens which I now have pleasure in exhibiting to this Society. Dr. Koningsberger tells me that the larva feeds on the ants and aphides that crawl over the coffee-twigs; pupation takes place in the burrow; oviposition has not been witnessed, nor have any but full-grown, or nearly full-grown, larvæ been found, so that it is not known if the burrow is enlarged to allow of the increase in size of its occupant, or if it is originally made large enough to accommodate the larva throughout its life. A figure of the larva is published in the above-mentioned work (Fig. 59), but it is evidently only a copy of the figure of a Cicindelid larva in Packard's "Guide to the Study of Insects," and is quite inadequate. The *Collyris* larva differs from the larvæ of the British *Cicindelæ* by its flattened femora, small size and more cylindrical body; the tubercles of the fifth abdominal segment bear a comb of three or four short teeth instead of one long hook, and these combs are better adapted for getting a purchase on the walls of a wooden burrow than would be the long hooks of some sand-burrowing *Cicindelæ*. I intend to make a careful and critical study of the mouthparts; as it is certainly unusual to find a predaceous larva with mouth-parts qualified to excavate burrows in wood. The mouth of the burrow is countersunk, and Mr. A. H. Hamm informs me that the same feature can be seen in the sand-burrows of the British *Cicindelæ*. I have no doubt but that the lower surface of the head of the *Collyris* larva fills completely the orifice of the burrow when the insect is awaiting its prey, the jaws projecting into the countersunk area. The adult *Collyris emarginatus* is arboreal in its habits, is remarkably fleet, and readily takes to wing; in Borneo, as I have shown (P. Z. S., 1902, vol. ii, p. 264), it is mimicked by a flower-haunting fly of the genus *Sepedon*; it feeds on small insects, and the statement in the Deutsche Entomol. Zeitschr.

1905, p. 172, that it is herbivorous is erroneous, and is due to a misunderstanding.

"I have also for exhibition some larvæ and pupæ of *Mormolyce*, together with a specimen of a *Polyporus* fungus split open to show the lenticular chamber excavated by the larva. The adults, male and female, are usually found resting on the under surface of these fungi, or on the tree trunk from which the fungus projects; oviposition has not been witnessed, but I believe that only one egg (or at most two) is laid at a time, for I have not been able to find more than one larva in the chamber,* though on one occasion I took a newly-emerged adult from the surface of a fungus in which was hollowed out a chamber containing one larva. Access to the larval chamber is attained by an orifice so small that it is surprising that the newly-emerged beetle can squeeze through it to the exterior, this orifice is situated on the upper surface of the fungus. It will be seen that there are no features of particular interest about the external appearance either of larva or pupa; these pupæ do not show the elongation of the head and thorax characteristic of the adult. Overdyk, who gives a bionomical account of this species in Ned. Ent. Vereen, vol. i, 1857, states that the larvæ are predaceous. The larva and the pupa have been figured and described by Verhuell (Ann. des Sciences Naturelles, 1847)."

Professor E. B. Poulton communicated the following note by Mr. A. H. Hamm, of the Hope Department, Oxford University Museum. The observations extend and support those recorded by him in "Proc. Ent. Soc. Lond., 1904," p. lxxv.

"The following observations made at Oxford during the present year, tend to confirm the opinion that *Pieris rapæ* chooses for prolonged rest, a surface upon which it will be concealed. Although only five individuals were observed, these had, without exception, selected a position of considerable protective value. The first butterfly was seen near Cowley Marsh on May 7th, at about 4 p.m. The afternoon

* The short note on this species which I published in British Assoc. Reports, 1901, was largely based on information supplied to me by a native collector, and this information, I regret to say, was proved afterwards by my own observations to be inaccurate.

was dull and cloudy, and the insect was resting in a semi-torpid state among the flowers of the white dead-nettle (*Lamium album*) in a hedge. A week later, on May 13th, between 4 and 5 p.m., when searching the same hedgerow, another individual was found in an almost identical position. Hanging in the midst of the largish white flowers of the Labiate the butterflies were beautifully concealed, and were indeed only found because the plants were carefully examined for other insects.

"On August 17th, between 7 and 8 p.m., when looking for larvæ on the hedge bordering my garden, near the Cowley Road, I found two *rapæ* within a few inches of each other. Both were resting on the silvery under-sides of bramble leaves. In both cases, however, the leaves were twisted and the lower surface had become the upper. Again, on August 20th, in a lane leading to Temple Cowley, at 5.30 p.m., I watched an individual flying slowly along a hedgerow, every now and then resting for a few seconds. Finally, after many attempts, it settled down, apparently for the night, and on going to look more closely, I found that it also had chosen the under-side of a bramble leaf. Although not quite so well concealed as among the white flowers, these last examples blended wonderfully well with their environment.

"After some years of close observation of the resting habits of insects in general, I feel convinced that they possess an inherent tendency to select an environment that aids in concealment; and as the various species differ in appearance so do they select diversified situations suited in each case to the particular requirement of the insect."

A discussion followed, Mr. H. J. Elwes expressing his conviction that the use of surroundings by insects, and Lepidoptera especially, for protective purposes simply, was still an open question. Colonel J. W. Yerbury mentioned the case of *Euchloë euphenoides* and *Zegris eupheme* roosting at Granada on plants of *Biscutella*, the appearance of the insects at rest closely approximating to that of the flower heads. Mr. H. Rowland-Brown observed that he had noted a similar resemblance between a specimen of *Pieris napi* and the flower of *Leucojum* on which it rested for the night. Mr. G. C.

Champion said that he had noticed specimens of *Gonepteryx rhamni* seek the under-sides of bramble leaves.

Dr. T. A. Chapman said that Col. Yerbury's observation on *Euchloë euphenoides* resting on the flowers of *Biscutella* is one that may be often made in the South of France, and few English Entomologists have not observed *E. cardamines* at rest on *Alliaria* flowers, or on some Umbellifer that roughly resembles it. These facts seem to give the clue to how the practice of these *Crucifer*-feeding Pierids of affecting objects of their own colour for resting arose. In so many of these cases, the food-plant is in flower when the butterfly is on the wing, and in the case of *Euchloë* the flower head is the place selected for egg-laying. It comes about, then, that the butterflies frequent the flowers of their food-plant, both for the honey they afford and for egg-laying. That it would often happen, therefore, to be the resting-place of the butterfly when overtaken by a sudden failure of sunshine is obvious. Nothing further is needed as a basis for natural selection to gradually accumulate in association, the characters of resting on the flower of the food-plant, and assimilation to it in colour.

A butterfly, searching for a flower head to rest on, will act of course in the same way as one searching for it for any other purpose, viz., it will discover at a distance an object of the desired colour, and will be able to verify what it really is, only after a close approach. If it wants to suck honey, or to lay an egg, such verification is imperative, and all collectors are familiar with butterflies closely approaching a piece of coloured paper, a dead leaf or other object, and only when quite close discovering that it is not the desired mate, or flower, and at once departing. But if a resting-place for the night is desired, such verification is not absolutely essential, and a place *must* be chosen, so that if after several tries a near approach only produces disappointment, an occasion at length occurs, when advancing evening makes it necessary to appropriate the resting-place without the final verification. Thus a *Pieris* or a *Euchloë* will learn to accept as a resting-place any white object, even if it be not a flower head of a Crucifer.

But if it be objected that cabbage and turnip, the usual

foods of our "cabbage" butterflies, have yellow flowers, the reply is that these foods, for these butterflies, are entirely human inventions, and therefore comparatively modern. Their natural foods have chiefly white flowers, such as, *Nasturtium*, *Arabis*, *Draba*, *Cochlearia*, *Thlaspi*, *Lepidium*, *Turritis*, *Alliaria*, and many others, the two last mentioned being the favourite foods of *E. cardamines*. It may also be suggested that the frequently very yellow under-sides of our common "cabbages" are due to the yellow flowers of our cultivated Brassicas, and of such wild Crucifers as *Raphanus sinapis*, and *Barbarea*.

The President, Mr. A. J. Chitty, Dr. F. A. Dixey, Professor E. B. Poulton, and other Fellows offered observations on the subject.

EXTRACTS FROM THE PROCEEDINGS

OF THE

ENTOMOLOGICAL SOCIETY OF LONDON

(February 7th—March 21st, 1906).

Wednesday, February 7th, 1906.

Dr. F. A. Dixey exhibited specimens of South African butterflies captured by himself and Dr. Longstaff, and remarked upon them as follows:—

"It may be remembered that at a recent meeting of the Society (Proc. Ent. Soc. Lond., 1905, pp. liv–lix), I gave some account of the scents observed by us in South African Pierines, calling attention to the fact that they were practically without exception of an agreeable character and confined to the male sex. On the present occasion I wish to speak of the perfumes detected by us in butterflies belonging to other groups; some of these odours having a similar character to those of the Pierines, while others belong to a different category.

"*Mycalesis safitza*, Hew. ♂. On separating the fore- and hind-wings, so as to expose the well-known 'tufts,' I at once perceived a strong odour of chocolate, perhaps combined with a trace of vanilla. This I noted at the time as 'one of the strongest butterfly scents known to me.' I found no odour in the female. Dr. Longstaff also detected a 'chocolate scent, not strong,' in the tufts of the male.

"Two males of *Mycalesis perspicua*, Trim., examined by Dr. Longstaff, emitted a 'very strong treacly odour—quite distinct from the scent of *M. safitza*.' To my perception the scent was rather of the *chrysippus* order, with a suggestion of burnt sugar or treacle. We had no opportunity of testing the female.

"Two male specimens of *Yphthima itonia*, Hew., and three of *Pseudonympha cassius* were tested by me with a negative result.

"The males of *Byblia goetzius*, Herbst, yielded a very distinct and agreeable odour of sweet chocolate, mingled, as in *Mycalesis safitza*, with a suggestion of vanilla. Dr. Longstaff reports a chocolate scent in the only specimen examined by him—a female.

"I found a similar chocolate scent in a specimen of *Gegenes oculata*, Trim. ♂. *Gegenes zetterstedti*, Wallgrn. ♀, was odourless, as also was a specimen (not yet determined) of *Pterygospidea flesus*, Fabr.

"*Planema aganice*, Hew., has been stated by Mr. Marshall (Trans. Ent. Soc. Lond., 1902, p. 413) to have no smell. The green juice exuded from a male specimen appeared to me to have an odour like that of a crushed cabbage leaf, which was by no means unpleasant.

"Both sexes of *Acræa alboradiata*, Auriv., have a distinct odour which is described by Dr. Longstaff as 'musty' and 'like old hay.' The female was independently noted by me as smelling like musty straw.

"The scent of *Acræa anemosa*, Hew., seems to vary greatly in strength in different individuals. One of the males tested by me had no apparent odour. Another male and a female both smelt strongly of damp, fusty straw. Dr. Longstaff's specimens, all males, gave a 'musty' odour of varying intensity. Mr. Marshall (*loc. cit.*) states that *A. anemosa* 'emits a very strong smell when pinched, being the only *Acræa* in which I have noticed this, though possibly *acara* does the same.'

"No odour was perceptible in the wings or crushed thorax of *Acræa cahira*, Hopff. ♂. Mr. Marshall (*ibid.*) reports that he was unable to detect any trace of bitterness or acridity in this species.

"Dr. Longstaff found a slight snuffy scent in the male of *Acræa encedon*, Linn., and an evanescent disagreeable odour, not very strong, in the female when crushed. The yellow juice of this species is said by Mr. Marshall to be slightly bitter, but not very markedly so.

"*Acræa doubledayi*, Guér. ♂, emits a yellow juice which on one occasion seemed to me to be scentless. In another male I detected a slight fusty odour. Dr. Longstaff reports an 'old hay' scent on crushing, in both male and female.

"Both sexes of *Acræa atolmis*, Westw., were found by Dr. Longstaff to possess a faint odour, which, however, he does not describe. I did not examine the female, but a male specimen appeared to me to be scentless.

"The smell of musty straw was very distinct in a female specimen of *Acræa caldarena*, Hew. It was only slightly apparent in a male examined by Dr. Longstaff.

"In *Acræa atergatis*, Westw., I found that the same musty odour was accompanied by a strong ammoniacal scent, like that of stable-litter.

"Both sexes of *Amauris echeria*, Boisd. (form *albimaculata*, Butl.), yielded a similar smell of musty straw, accompanied in this case by an evanescent sharp or pungent scent like that of vinegar. A considerable amount of yellow juice, which seemed to be tasteless, was exuded by one male specimen. The characteristic smell adhered to the fingers after crushing a female specimen, though in this instance no fluid was seen. In regard to *A. echeria*, Mr. Marshall remarks that in the few specimens that he tried, no juice was emitted; but they had a nauseous taste and a strong smell which reminded him somewhat of that emitted by many *Coccinellidæ*. Dr. Longstaff observed the musty smell and the transient pungent odour in both sexes; the latter he compares to acetylene. One female was noted by him as possessing 'a disagreeable odour like some animal.'

"The scent in both sexes of *Limnas chrysippus*, Linn., invariably appeared to me to be of a strong and disagreeable nature, like that of cockroaches, often stronger in the female. The odour of the male seemed to contain an additional constituent, which I am inclined to compare to the perfume of burnt almonds. I found no increase of the scent when the glands of the hind-wing were crushed with the forceps. Dr. Longstaff noted a disagreeable odour in both sexes—stronger in the female—which he likens to that of musk-rats or cockroaches. The excised glands of the male yielded on pressure a yellow or brown juice, without perceptible taste or odour. (For his impressions of *L. chrysippus* in India see Trans. Ent. Soc. Lond., 1905, pp. 87, 89, 108, 137.) That great individual differences exist in the appreciation of these scents appears

from Mr. Marshall's statement that in his experience *L. chrysippus* emits no smell.

"A specimen of *Charaxes varanes*, Cram. ♂, on being squeezed, emitted an odourless yellow juice. Another was noted by Dr. Longstaff as having a 'treacly' odour. A female was thought by him to have a smell like cowdung. To me the scent of the same specimen recalled that of *L. chrysippus*.

"*Salamis anacardii*, Linn., has an animal-like scent which to Dr. Longstaff suggests the odour of rabbit-hutches. It appears to be stronger in the female. This may be compared with Wood-Mason's statement that the females of *Papilio dasarada*, Moore, 'had the strong scent of caged porcupines with a touch of musk' (Journn. Asiat. Soc. Bengal, 1886, Vol. LV, Part II, No. 4, p. 374).

"Three specimens of *Neptis agatha*, Cram., captured by me in Natal, emitted a strong and very disagreeable scent, much like that of *L. chrysippus*, but more intense. Two specimens from the Zambesi, however, are reported by Dr. Longstaff as having a 'slight sweet scent,' and '? slight scent' respectively. The Natal and Zambesi forms of this species certainly differ in aspect, and it may be that a corresponding difference exists in their scent-producing capacity. All five specimens seem to be males.

"I found no smell in *Neptis marpessa*, Hopff. ♂.

"A male specimen of *Hypolimnas misippus*, Linn., had a smell like coffee; not very strong.

"The male of *Hamanumida dædalus*, Fabr., was found by me to smell like burnt sugar, or caramel toffee. A similar scent of burnt treacle, accompanied by a 'fairly strong animal scent,' was noted in another male specimen by Dr. Longstaff. In two others, when dead, he detected a 'mousy' odour.

"I could find no scent in *Eurytela hiarbas*, Drury, ♂. Dr. Longstaff records of two specimens (sex undetermined) '? snuffy scent.'

"*Precis clelia*, Cram. ♂, is said by Dr. Longstaff to have a treacly scent.

"The smell of fusty packing-straw, so common among the *Acræas*, is also found in *Papilio demodocus*, Esp. It is sometimes combined with a smell that suggests cabbage-water, or a

kitchen sink, and was found by Dr. Longstaff to be stronger in the female than in the male.

"*Papilio cenea*, Stoll, ♂, has a similar odour; less 'musty,' according to Dr. Longstaff, than that of *P. demodocus.*

"*Papilio lyæus*, Doubl. ♂, is occasionally scentless. A few specimens were found by Dr. Longstaff to have an odour, more or less pronounced, which he describes as 'sweet, luscious, flowery.'

"A specimen of *Papilio leonidas*, Fabr. ♂, had a scent which to my mind seemed like that of *L. chrysippus.* Other specimens, however, all males, were described by Dr. Longstaff as having a 'strong, sweet, "white flower" scent, followed by something more spicy.'

"Lastly, it may be mentioned that the Geometrid *Cartaletis libyssa*, Hopff., which no doubt belongs to the synaposematic group headed by *L. chrysippus*, exuded when pinched a yellowish juice like that of an *Acræa.* This juice was scentless.

"It will be observed that in some of these cases, *e. g.* in *Mycalesis safitza*, the fragrance resembles that of the Pierines mentioned on a former occasion in being agreeable in character and confined to the male sex. The inference seems fair that odours of this kind are employed as a means of sexual attraction and perhaps of recognition. Mr. Wood-Mason (Journ. Asiat. Soc. Bengal, 1886, Vol. LV, Part II, No. 4, pp. 343–393) found many years ago that the males of several Indian butterflies belonging to the genera *Danisepa*, *Mycalesis*, *Lethe* and *Thaumantis*, exhaled a pleasant fragrance of vanilla, the corresponding females being scentless; one species of *Mycalesis* indeed received from Wood-Mason and de Nicéville the name of *suaveolens* on this account. These instances clearly belong to the same category.

"The case is different with the odours of several *Acræas* and some *Papilios*, in which the scent has been found to be disagreeable or even disgusting. The possessors of such malodorous perfumes are generally such as we should on other grounds suppose to be distasteful; and it is significant in this connection that these unpleasant scents are as a rule shared by both sexes, and indeed often show a marked tendency

towards greater intensity in the female. This is of course precisely what we should expect on the hypothesis of their value as a means of protection.

"In a former communication (Proc. Ent. Soc. Lond., 1905, p. lv), I mentioned the possibility that both kinds of scent may occur in the same species; I have some reason to think that this is the case with *L. chrysippus*. The males of three common species of *Mylothris*, viz., *M. agathina*, *M. ruppellii* and *M. trimenia*, possess a well-marked and very agreeable odour of which the females show no trace (Proc. Ent. Soc. Lond., 1905, p. lviii). There are, as is well known, strong grounds for believing this to be a distasteful genus, and it is noticeable that both sexes emit on pressure a yellow or greenish juice like that of an *Acræa*. I was never able to convince myself that any odour attached to this juice, or, except in one case (a female) to the crushed body. But it is quite possible that an observer with a more acute sense of smell than I possess might arrive at a different result. The disagreeable odours of the *Euplœa* group are well known, but Wood-Mason (*loc. cit.*) records that in *Euplœa* (*Danisepa*) *rhadamanthus*, Fabr., 'the eversible caudal rosettes of the males are finely vanilla-scented.' A still more conclusive instance, also noted by Wood-Mason, is as follows:—'The gland covered by a patch of modified scales and by an erectile wisp of hairs on each hind-wing in the male (of *Stichophthalma camadeva*, Westw.) secretes a fluid that gives out a pleasant odour distinct from, but so faint as to be barely perceptible in the presence of, a much stronger odour (resembling that of sable fresh from the furrier's shop), which is common to the two sexes.'

"A point of much interest in connection with these scents, their diverse characteristics and presumably diverse significance, is the probability thus suggested of a certain correspondence between human æsthetic preferences and those of some at least of the lower animals."

The general character—agreeable or the reverse—of the odours emitted by the various species shown, as also the property belonging to some of them of exuding a yellowish or greenish fluid on pressure, was indicated in the exhibit by means of coloured labels.

The Rev. A. E. Eaton inquired whether the coloured juice was exuded from any particular pore, and suggested that when crushed it would be worth while to put the specimen into a solution of formaline, as he had noticed that in some species under this treatment certain pores of the antennæ were extruded, and that the liquid came, not from the air tubes, but from some special processes.

Mr. G. C. Champion mentioned that he had observed a fluid exuding from the thorax of many Anthrocerids, and Dr. G. B. Longstaff said that he had found the expression of fluid from the antennæ so usual in collecting that he shifted his specimens in papers after a short time to prevent them adhering to the envelopes.

A discussion followed on the organs and uses of scent for purposes of attraction and defence in insects generally, Mr. J. W. Tutt drawing attention to the fact that there are two glandular scents in Lepidoptera: the one emanating from the androconia; and the other from the body, and that in determining the scent peculiar to the various species they must be distinguished.

Professor Poulton, in congratulating Dr. Dixey and Dr. Longstaff upon the interesting results of their careful observations in the field, referred to the fact that the scents observed in the males alone, and presumably epigamic in significance, were pleasing to the human sense, whereas those common to both sexes, and presumably aposematic, were unpleasing to man. *Ex hypothesi*, the first set appealed to the sense of the female insect, the second to that of insect-eating vertebrates. That the former should be agreeable to man appeared to be a far more astonishing result than that he should find the aposematic scents unpleasant. Professor Poulton also mentioned having seen in a dissection of the larva of *Cossus*, prepared by Mr. O. H. Latter, a long tubular gland emitting the odour peculiar to that species. The President, Dr. T. A. Chapman, Mr. G. Bethune-Baker, Mr. M. Burr, Mr. G. J. Arrow and other Fellows continued the discussion, at the close of which Dr. Dixey replied, reminding Mr. Tutt that he had already dealt with "androconial" scents on two former occasions. It was of course

true, as he had previously stated (Proc. Ent. Soc. Lond. 1904, p. lviii) that the sexual scent in many Pierines, Lycænids, Satyrids and Nymphalids was distributed, though not manufactured, by specialised scales either scattered over the wings or collected into patches. At the same time it was worth noticing that in some species, e. g. *Ganoris brassicæ*, which were plentifully supplied with "androconia," the scent was barely or not at all perceptible; while in *Gonepteryx rhamni* and *G. cleopatra*, both of which, and especially the latter, had been found to possess a flower-like odour, he had been unable to detect any scales specialised for scent distribution. He was not at present prepared to assert, from his observations in the field, that the repulsive odours were in all cases confined to the tissues and juices of the body; though in some instances the intensity of such odours was certainly increased when the thorax was crushed.

Dr. G. B. Longstaff exhibited four species of *Acræa* taken in South Africa during the visit of the British Association, viz.:—

1. *A. anemosa*, Hew., from the Victoria Falls, and Mochudi in Bechuanaland. Both sexes in good condition.

2. *A. alboradiata*, Auriv., previously known to Mr. Roland Trimen by two females only, and considered by him as a variety of *anemosa*. This species was abundant near the hotel at the Victoria Falls, flying about the tops of trees, late into the afternoon, or even at dusk. The females were in far better condition than the males. After examining a long series Mr. Trimen is disposed to think it a distinct species, which should bear the name given by Aurivillius to Mr. Trimen's original specimen when believed to be merely a variety of *anemosa*.

3. *A. atolmis*, Westw. In the Hope Collection are Westwood's types of two forms of this, to which he gave the names of *atolmis* and *acontias*. There seems no doubt they are one species. They were taken by F. Oates near the Victoria Falls in January, 1875. Mr. Trimen has specimens from Damaraland. Some of the specimens exhibited retain much of the brilliant red colouring which is so striking in fresh specimens during life. The darker specimens resemble Prof.

Westwood's *acontias*. Occasionally seen flying high, *atolmis* is more common nearer the ground, being much addicted to drinking from wet mud on the banks of the Zambesi, or at patches of irrigation in the hotel garden.

4. *A. atergatis*, Westw. The two types of this are in the Hope Collection at Oxford, having been taken by F. Oates near the Victoria Falls in January, 1875. There are also two specimens in the National collection. Dr. Dixey took four specimens near the Falls.

The other three species exhibited were commoner and fell to the nets of Dr. Dixey, Professor Poulton, and the exhibitor.

Professor E. B. POULTON, F.R.S., exhibited two Diptera, which had been observed following the bee, *Andrena labialis*, Kirb., by Mr. A. H. Hamm, assistant in the Hope Department, Oxford University Museum. The specimens have been compared with Mr. G. H. Verrall's collection and identified as *Chortophila unilineata*, Ztt., by Mr. J. E. Collin. Mr. Hamm's notes were as follows:—

"During the afternoon of May 27th, 1900, I was sitting watching a fairly numerous colony of *Andrena labialis*, nidificating on the sloping side of a small clay pit, near Bagley Wood, Oxford. My attention was arrested by the surprising behaviour of a fly, which kept following up a ♀ bee in the most persistent manner. The bee seemed conscious of the attention of the fly, and instead of making direct for the burrow, it zigzagged about and sometimes alighted on the ground, as if endeavouring to get rid of its pursuer; but the fly was not to be shaken off; for it followed the bee in all its movements, settling on the ground and resuming its flight at the same time as the Aculeate. Throughout this persistent pursuit the fly kept at a fairly uniform distance of about six inches behind the bee. I saw about six of these flies altogether, but no single bee was followed by more than a single fly. I netted the two flies exhibited by Professor Poulton, in one case capturing pursuer and pursued at a single sweep."

Professor POULTON stated that new and interesting light had been thrown on the observation by Col. Yerbury, who pointed out that both flies were males. At first sight it

seemed astonishing that the bees should be pursued by the males of inquiline flies; but Professor Poulton suggested the males in this way find their way to the burrows, where they meet the females which have also reached them in the same manner, or where more probably they lie in wait for the freshly emerging females.

The Rev. A. E. Eaton doubted that the object of the male flies following the bees was to be guided to where the female flies were likely to be found. He remarked that these *Diptera* frequent the *Andrena* colonies and have no need to be guided to them. And might not these males have chased the bees just as *Vanessidæ* and *Hesperiidæ* dart at and pursue any *Bombus* or *Pieris* that happens to fly past their resort?

Professor Poulton considered that the cautious and persistent tracking described by Mr. Hamm was inconsistent with Mr. Eaton's suggestion.*

Wednesday, March 7th, 1906.

Professor E. B. Poulton exhibited the original African Journal written by W. J. Burchell, between May 24 and September 2, 1812, both days inclusive. The account of this part of his journey occupied the whole of a small notebook bound in sheep-skin, and still in the most beautiful condition. In a lecture before the British Association at Cape Town, on August 17 of last year, Professor Poulton had

* Since the meeting of the Society on February 7th, the two flies have been further examined by Mr. J.E. Collin, who writes, Feb. 19th, 1906 :—"After a microscopical examination I consider them undoubtedly *females*: all Mr. Verrall's are females, but there is a male among the specimens in his European collection from Kowarz." The two specimens had been previously studied with the lens, but not the compound microscope, by Col. Yerbury, Mr. E. E. Austen, and Mr. Collin himself; and all three Dipterists had then considered them to be males. It is fortunately possible to correct the mistake on the very page in which it is printed. The story enforces Darwin's conclusion that errors of fact are more dangerous than errors of hypothesis.

The eyes of these female flies are of a size and relative position which seem to imply the male sex. The eyes of male flies in general are probably chiefly developed for the pursuit of the female, and it may well be that they are similarly formed in these females in order to aid in the pursuit of the Hymenopterous host. [E. B. P.]

mentioned the unfortunate loss of the journals in which Burchell recorded a general account of his doings during the five years (1810–15) in Southern Africa and the five (1825–30) in Brazil. His classical work, "Travels in the Interior of Southern Africa," does indeed give a complete record between November 26, 1810, and August 3, 1812,—the day on which he brought to a conclusion his first visit to Litakun, the capital of the Bachapins, in what is now British Bechuanaland. Mr. Mason, head-master of the Boys' High School at Rondebosch, near Cape Town, who was present at the lecture, told Professor Poulton that a former pupil of his, named Burchell, had brought to school a diary written by an ancestor in St. Helena. Through Mr. Mason's kind help Professor Poulton was put into communication with Mr. Francis A. Burchell, a grand-nephew of the great explorer, who has most kindly lent the deeply interesting note-book now exhibited to the Society. At the place where Burchell's second volume comes to an end, the words "end of the 2nd volume" are written in pencil in the margin. Beyond this point one month of the lost records are here restored to us, from August 3 to September 2, 1812. Furthermore even in the period covered by the published work there are many statements of the deepest interest to us which Burchell withheld. For the first time we are made acquainted with the day and month of his birth. It is believed—but there is no certainty—that he was born in the year 1782. July 23, 1812, was a day of great anxiety and trouble. Among his attendants was a man named Cornelis, of Hottentot and Dutch parentage. Cornelis had been unsatisfactory and useless from the day of his engagement when he presented himself "in a state of complete intoxication," and now in the midst of the Bachapin capital, Litakun, then visited for the first time by a European, he broke out into open rebellion, and Burchell was compelled, buckling on his pistols and cutlass, personally to enforce obedience. The published account ends with the words :—"Thus ended one of the most turbulent days which I had experienced since the commencement of my journey." ("Travels," vol. ii, London, 1824, p. 462.) The manuscript journal, however, concludes the day with the following personal details omitted from the second volume :—

"I continued in the waggon all the evening, and to divert my mind from the past, I spent the remaining time with my flute."

"It thus has unfortunately happened that I have been prevented joining my family in their remembrances of me on this day: and that my birthday should be marked as one of the most turbulent days I have passed since landing on Africa. From the little dependance I can place on my own people my situation now begins to grow critical, and calls for the most resolute but prudent measures."

Another record of great interest to the Society is found under the date May 29, 1812, when Burchell was at Klaarwater (Griquatown) making arrangements for his journey to Litakun. It is contained in these words:—"The Sphinx Atropos is called by Colonists the *Bye-mot* or *Duyvel-bye*, and is firmly believed to be poisonous."

This sentence appears to have been written later than the brief record of the day, the writing being in a darker ink and compressed into the narrow space between the entries for May 29 and 30.

Mr. Roland Trimen's observation of the superstitious dread of this species in South Africa is thus both confirmed and carried back to a much earlier date. (Trans. Ent. Soc. Lond. 1902, p. 402.)

Professor Poulton exhibited a specimen of the large Melolonthid beetle *Lepidiota bimaculata*, Saunders, and directed attention to the two white eye-like spots on the elytra, and to the tapering posterior abdominal segments which suggested the appearance of the snout of a small mammal. The relative position of the eye-like spots and apparent snout was such as to promote the deceptive resemblance, which was also strongly assisted by the regular shape of the white spots, the direction of their long axes, and the fact that they lay in the shadow of a low but district ridge. Similar appearances were to be seen in several allied species, and Professor Poulton suggested that there were conditions during life in which the anterior part of these beetles was concealed, as it might be by foliage or by burrowing, and that the appearance of the exposed posterior part then acted as a defence. Professor Poulton had been led to draw attention to this example, which

had been long known to him, because of the obvious and interesting analogy with the interpretation of the powerful posterior legs of the male *Heterochelus*, sp., offered by Dr. G. B. Longstaff at the last meeting of the Society (p. 93).

Dr. F. A. DIXEY exhibited specimens of *Pierinæ* belonging to the following species:—*Terias læta*, Boisd., *Teracolus puellaris*, Butl., and *T. danaë*, Fabr. (India); *Terias brigitta*, Cram., *Teracolus annæ*, Wallgrn., *T. speciosus*, Wallgrn., *T. auxo*, Luc., *T. omphale*, Godt., and *T. eris*, Klug (Africa); *Terias delia*, Cram., *Xanthidia nicippe*, Cram., and *Pyrisitia proterpia*, Fabr. (America). The under surfaces of the "wet" and "dry" phases were in each case shown side by side, in order to illustrate the very general tendency in these and other species to assume a reddish coloration beneath in the dry season. This tendency was most marked in the American forms shown, and least marked in the Indian; but was clearly seen to be common to all three Continents. The reds varied in character—sandy-orange, terra-cotta, Indian red and brick-purple being all represented; and the contrast with the usually pale appearance of the under surface in the wet season was in every case very distinct.

Dr. Dixey remarked that it could hardly be doubted that this infusion of red in the "dry-season" forms had a cryptic significance, and stood in relation with the very general prevalence of a reddish coloration, mostly due to the presence of iron, in the sandy wastes and bare patches of soil which formed a prominent feature in the tropical and sub-tropical regions inhabited by these and kindred species. He had himself observed that when the dry-season form of *Teracolus speciosus* settled on the red sandy soil of the "Bluff" at Durban, and then closed its wings so as to conceal the whole of the fore-wing except the tip, the uniform red of the under surface as then displayed made the insect very difficult of detection. A general redness of soil, recalling that of parts of the Devonian system in England, was characteristic of large areas of the African Continent; and Dr. Longstaff had informed him that similar conditions prevailed in India and China. The species exhibited were generally ground-haunting; and in all cases the reddish tinge of the under surface extended to the tip of

the fore-wing as well as to the entire hind-wing, thus involving just so much of the wings as was exposed during rest. He considered that the present series of specimens tended to illustrate and confirm Professor Poulton's view of the generally cryptic character of "dry-season" phases.

Professor E. B. Poulton, F.R.S., read a paper entitled 'Notes upon some remarkable parasitic insects from North Queensland" by F. P. Dodd, F.E.S., and exhibited the fine and carefully labelled material sent by the author. This material consisted of a series of *Braconidæ* bred from Lepidopterous hosts, *Chalcididæ* from Lepidopterous and Hymenopterous hosts, and a new Cyrtid fly of the genus *Ogcodes,* bred from the Attid spider, *Cosmophasis bitaeniata*, Keys. The accurate observations upon these parasitic species render the paper of much value. Thus the host of the extraordinary and beautiful Chalcidid genus *Schizaspidea* of Westwood has never before been observed; but Mr. Dodd records that the specimen obtained by him—an example of a new species—was bred from the pupa of a large ant of the genus *Camponotus.* Professor Poulton desired to express his warm thanks for the kind and cordial help he had received from distinguished naturalists, in naming and describing the material, communicated to him by Mr. Dodd. In an Appendix to the paper the new forms of *Braconidæ* and *Chalcididæ* were described by Colonel C. T. Bingham, and the new Cyrtid fly by Dr. Benno Wandolleck of Dresden. The ants had been kindly named by Professor Auguste Forel of Morges, and the Attid spider by Dr. G. W. Peckham of Milwaukee.

Dr. G. B. Longstaff read a paper "On some Rest Attitudes in Butterflies," illustrated by numerous specimens arranged upon backgrounds of specially-prepared sand-paper approximating to the natural surroundings of the insects in their various habitats.

Dr. T. A. Chapman understood that Dr. Longstaff's remarks referred chiefly to resting attitudes during quiescence, when invisibility was desired, but the heliotropic attitude with tail to the sun, was familiar to observers of Vanessas and other Nymphalids—and some other butterflies of the European fauna. During their active period, when, settling, usually on

the ground, they assumed that orientation, and spread their wings flat on the ground with the head a little raised, making the greatest display of their colours, but chiefly appearing to desire to secure as vertical a sun as circumstances allowed; this might be different in the tropics. He wished to ask how and how far these two phases of a similar orientation were related.

Professor E. B. Poulton congratulated the author on the many interesting facts and observations contained in his memoir. There was neither time nor opportunity to consider these in detail; but the speaker felt that he must express his deep interest in the principle suggested by Dr. Longstaff at the conclusion of his account:—that in the tropics there were many hours of daylight during which insects were at rest and their enemies active. It was clearly a principle of the utmost importance, which must be seriously taken into account in observing and recording bionomic data.*

* Since the meeting of the Society on March 7, I have remembered the very interesting observations published in 1900 by Mr. N. Annandale, of the Indian Museum, Calcutta. The author, observing the habits of certain Phasmidæ and of a beetle larva, is led to conclusions very similar to those reached by Dr. Longstaff from the habits of Lepidoptera. ("Notes on the Habits of Malayan Phasmidæ, and of a Flower-like Beetle larva," by Nelson Annandale, B.A., Proc. Roy. Phys. Soc. Edinb. 1900, No. xxix, pp. 439–444.) In this communication Mr. Annandale describes a dull-red species of Phasmid, *Lonchodes*, sp., nearly four inches long, which, in the full blaze of the mid-day sun, is freely exposed on "the upper surface of certain broad leaves such as abound in neglected hill clearings." Even from below "its shadow was perfectly visible through the translucent tissues of the leaf."

"I was quite unable to discover what became of them at night, for I never found them on the leaves either late in the afternoon or early in the morning. Most probably they remained concealed among the undergrowth except during the heat of the day.

"The Phasmid . . . is only conspicuous at certain times of day, when the sun is at its hottest and brightest. . . . . At mid-day, the mammals, birds and amphibians of the jungle are at rest. They are not asleep, but they do not search actively for food, nor come out of the wood into the clearings. . . . . Lizards, of course, are generally most active when the sun is hottest; but in these hill-clearings reptiles of all sorts are rare. . . . . I have a certain amount of negative evidence that the majority of Malayan Phasmidæ are most active in the middle of the day, being inclined to remain concealed in the early morning and late afternoon. . . . . Too late or too early in the day, it was impossible to see a single stick-insect in the clearing; and during my six months' stay in Lower Siam, I never was able to discover any Phasmidæ of any species late in the afternoon." Mr. Annadale however found a single specimen in the early morning clinging motionless, like an enormous Geometrid larva, to a blade of grass, and remaining "absolutely still while the grass was broken off." Towards the end of the paper Mr. Annandale describes the habits of a flower-like beetle-larva (apparently an Endomychid), which, "early in the

Upon Dr. Chapman's suggestion that butterflies assume a position with their heads directly away from the sun in order to receive as much heat as possible, the speaker wished to point out, that when the wings are raised over the back, this was the very position which insured a minimum of heat. The size of the shadow cast is a criterion of the amount of heat intercepted and in this position with the wings upright the shadow becomes a mere line. When the wings of a butterfly resting in this position on the ground are fully opened, there is, it is true, some very slight compensating gain of heat, wherever the sun's rays strike the earth obliquely. The head of the butterfly being turned from the sun, the raised costal margins of its fore-wings insure that the heat rays strike the plane of the wings with slightly less obliquity and therefore with more thermal effect than they do the ground.

Referring to the "list" of butterflies in the resting position Professor Poulton said that, on one occasion many years ago, he had observed this movement in a pronounced degree in the Green Hairstreak (*Thecla rubi*). The butterfly was observed at rest on the flat surface of a leaf at Birdlip, Gloucestershire, and it let itself down on one side so completely that it seemed to lie flat on the leaf. The obliteration of shadow was very marked and had at the time forced itself upon the speaker's mind as the significance of the attitude.

Dr. F. A. Dixey said that he was much struck with the fact pointed out by Dr. Longstaff, that there were several hours of daylight during which most butterflies were inactive, and were therefore fully exposed in the resting position to the attacks of insectivorous enemies. This could hardly fail to have an important influence on their postures and colouring. To the evidence lately adduced in favour of the selection by butterflies of appropriate surroundings for their concealment during

morning, as late as two hours after sunrise (which occurs in Patalung between five and six o'clock)," rests "motionless in the angle formed by the leaves with the stem" of its favourite plant. These same larvæ are, he states, extremely active during the heat of the day. As possibly bearing upon these habits the author remarks that "The hour immediately preceding and following upon sunrise is the time of the greatest activity of many Malayan animals, for both nocturnal and diurnal species are often then at work." At the same time, Mr. Annandale is careful to point out that nothing is "known as to the enemies and dangers to which this particular insect is exposed." [E. B. P.]

repose, he might add the testimony of Mr. R. M. Christy, who observed a black and yellow *Papilio* choosing, after much fluttering, to settle on a twig of *Betula glandulosa* bearing withered leaves of a similar yellow colour. (Proc. Ent. Soc. Lond., 1885, p. ix.) There were some interesting records by Captain Clements, R.A.M.C., who observed that "*Papilio merope* ♂ almost invariably selects a broad-bladed grass, striped with brown and yellow, and, hanging pendent from its extremity with the wings folded, the upper ones being covered over and concealed by the lower, it cannot be seen until it is again startled into flight. Another butterfly, in this case the female, which selects a resting-place which effectually conceals it, is *Catopsilia florella*; this yellow insect has small round silvery spots surrounded by a narrow brown margin on its wings. When near a mango-tree, of which some few of the leaves are of a bright yellow colour, dotted with spots identical in colour, shape, and disposition with those above described, it invariably selects these leaves for settling on, and is then very difficult to detect." ("On a Collection of Sierra Leone Lepidoptera," by W. Schaus and W. G. Clements, London, 1893.) The last observation, he thought, afforded a very complete parallel with the case of *Eronia cleodora*; and the evidence collected from so many quarters appeared to be conclusive as to the prevalence, throughout a wide range of species, of this habit or faculty of selection.

The PRESIDENT, Mr. H. ROWLAND-BROWN, Mr. G. C. CHAMPION and other Fellows joined in the discussion.

Wednesday, March 21st, 1906.

Dr. DIXEY exhibited male and female examples of Pierines belonging to the genus *Eronia* with the closely-allied genera (or subgenera) *Nepheronia* and *Leuceronia*. He drew attention to the great diversity of aspect that obtained between different members of this group, especially the females, and showed that in many instances this was due to the fact that one or both sexes of the *Eronia* had been assimilated in aspect to a form or group of forms either known or suspected to be distasteful.

He believed the association to be in most cases synaposematic (Müllerian) rather than pseudaposematic (Batesian); but it was perhaps possible that in *Eronia leda*, which possessed a cryptic under-side, we had a case of true mimicry. *Eronia cleodora*, Hübn., which was more closely related to *E. leda* than were any of the forms shown, was not a mimic; its sexes were similar to each other, and both male and female appeared to trust for protection to their cryptic under surface. The same was probably the case with the female of *E. leda*, which also seemed not to be a mimic; but the male in this instance, though to some extent cryptic beneath, was an excellent copy of another Pierine, viz. *Teracolus auxo*, Luc., or of its northern form *T. incretus*, Butl. On these grounds the presumption was that both *E. cleodora* and its congener *E. leda* were less distasteful than other members of the *Eronia* group, and it seemed therefore possible that the mimicry by *E. leda* ♂ was Batesian, the female finding perhaps a more effective defence in the cryptic colouring of its under surface. In the remaining cases there was less reason to presume edibility, and the females had become powerfully affected by other protected forms of various affinities.

With respect to some of the "models," the evidence of the distasteful quality of the groups represented by *Tirumala limniace* and the two species of *Mylothris* was generally admitted to be strong. There appeared to be no direct evidence as to *Nychitona medusa*, but it had the habits of a protected form; while *Huphina phryne* (*nerissa*) was found by Mr. Finn, as a result of many experiments, to be disliked by several insectivorous birds.

The species shown were as follows, a specimen of the "model" being in each case placed beside the form which resembled it:—

Nepheronia hippia, Fabr.,	associated with	*Tirumala limniace*, Cram.
N. avatar, Moore,	,,	*Huphina, nerissa*, Fabr.
Leuceronia thalassina, Boisd., (♀ with brown upper wings.)	,,	*Mylothris spica*, Mösch. ♀.
L. argia, Fabr.,	,,	*M. rüppellii*, Koch ♂.
L. pharis, Boisd.,	,,	*Nychitona medusa*, Cram.
Eronia leda, Boisd.,	,,	*Teracolus incretus*, Butl.

Report of the Hope Professor of Zoology, 1903.

Among the large numbers of specimens recorded in this Report it is difficult to single out any gifts for special mention, so many are donations of unusual value.

The African material is, as on other occasions the most important, including the splendid bionomic accessions and fine additions to the general collection captured in Rhodesia and presented by Guy A. K. Marshall, Esq.; the immense and valuable collection of butterflies from the neighbourhood of Lake Victoria Nyanza presented by C. A. Wiggins, Esq.—a collection described by Mr. Roland Trimen, F.R.S., as the finest consignment he had ever seen from a single district; the important collection from the same area, presented by A. H. Harrison, Esq.; from the tropical West Coast the smaller but valuable collections presented by Sir George Denton from Gambia, and C. J. M. Gordon, Esq., B.A., Balliol College, from Southern Nigeria; the small but deeply interesting series from Lake Tana, Abyssinia, presented by Dr. A. J. Hayes of Cairo; the large and very valuable series of South African Hymenoptera Aculeata presented by F. N. Brown, Esq.

From the Oriental region the donations have been unusually large and interesting, including nearly the whole of the valuable material described in Proc. Zool. Soc., 1902 (pp. 230–284), and figured in the accompanying five plates (XIX–XXIII), presented by R. Shelford, Esq., M.A., Christ's College, Cambridge; the fine collection from Lower Siam presented by N. Annandale Esq., B.A., Balliol College, and H.C. Robinson, Esq.; the valuable set of beetles from Southern India presented by Mrs. R. Imray and the Rev. A. Thornley, M.A., F.L.S.; the very useful series of butterflies from British New Guinea, purchased from Mr. H. S. Rohu.

From America the accessions include an extremely valuable set of named moths, presented by W. Schaus, Esq., F.Z.S.; a very fine series of insects from Jamaica, presented by C. B.

Taylor, Esq., F.E.S.; valuable donations from British Guiana, presented by W. J. Kaye, Esq., F.E.S., and from the Bahamas by C. V. A. Peel, Esq., F.Z.S.

From Europe an unusual number of valuable collections have been received, including the fine series from Cyprus presented by Miss Dorothy M. A. Bate; from Greece by W. M. Geldart, Esq., M.A., Trinity College; from Spain by Dr. T. A. Chapman and by the Professor; from Central and Northern Europe by E. L. Meyer, Esq.; from Russia by Hamilton H. Druce, Esq., F.Z.S., F.E.S.

Among the numerous accessions to the British collections must be mentioned the series of nearly 1,000 named Diptera presented by Col. J.W.Yerbury, F.Z.S., F.E.S.; the valuable Coleoptera presented by H. St. J. Donisthorpe, Esq., F.E.S.; the specimens of a beetle new to the British list (*Gynandrophthalma affinis*), discovered and presented by Mr.W. Holland; and the two specimens of the rare noctuid moth (*Polia xanthomista*) presented by Dr. F. A. Dixey.

Not confined to any of the categories mentioned above is the kind donation of large numbers of valuable specimens from many localities by Herbert Druce, Esq., F.L.S., F.Z.S., together with the deeply interesting mimetic Lepidoptera from South-east China, &c., presented by Monsieur Charles Oberthür.

Six members of the Council of the Entomological Society were present at the annual visit to Oxford for the first Saturday to Monday in July. There were present on July 4 to 6 the Treasurer, Mr. R. McLachlan, F.R.S.; the Secretaries, Mr. Herbert Goss, F.L.S., and Mr. H. Rowland-Brown, M.A., University College; the Rev. F. D. Morice, M.A., Queen's College; Mr. Arthur J. Chitty, M.A., Balliol College; and Mr. Hamilton H. Druce, F.Z.S.; together with the following entomologists: Professor R. Meldola, F.R.S.; Mr. Edward Saunders, F.R.S.; and Mr. H. St. J. Donisthorpe. The Proctors and Dr. F. A. Dixey kindly helped to make the visit a success.

Other kind friends of the Department have studied parts

of the Collections or Library in Oxford during the year: Mr. W. J. Lucas, F.E.S.; Mr. Norman H. Joy, F.E.S.; Mr. G. A. James Rothney, F.E.S.; Mr. W. J. Kaye, F.E.S.; the Rev. Henry L. Gorham, F.Z.S., F.E.S.; Mr. Herbert C. Robinson, Curator of the Museum at Kuala Lumpur, Selangor, Malay Peninsula; Mr. Hamilton H. Druce, F.Z.S., F.E.S.; Mr. Roland Trimen, Hon. M.A., F.R.S.; Mr. A. H. Harrison; Colonel J. W. Yerbury, F.Z.S., F.E.S; and Mr. R. I. Pocock, F.Z.S.

The Hope Department has been also visited by Dr. Henry Wilde, Hon. D.C.L., F.R.S.; Sir Oliver Lodge, Hon. D.Sc., F.R.S.; Professor Sydney J. Hickson, M.A., F.R.S.; Mr. William H. Wilson, M.A., B.M., Keble College, of the Cairo Medical School; and Professor H. V. Kingsford, of the Dartmouth College, N. H., U. S.A.

Early in the year 1903 Mr. W. Holland finished the arrangement of the *Acraeinae* in new cabinets, thus filling up all the available space. The further arrangement of the Rhopalocera was therefore abandoned after the last section of the *Lycaenidae*, kindly named by Mr. H. H. Druce, F.Z.S., had been provisionally placed with the rest of the family in an old cabinet. Mr. Holland then began an important piece of work upon the Coleoptera, clearly labelling and determining the "types," with precise reference to the original descriptions. In this way a large number of these historic specimens, chiefly described by Westwood and Hope, are now made readily available for the study of the specialist. As the types of each family were worked through, Mr. Holland wrote the list in a special volume of "Types &c., in the Hope Department, O. U. M.," where they can be easily consulted. Much uncertainty will thus be avoided and much time gained. As soon as this important work was taken in hand, it became clear that certain parts of the collection, for example the *Lucanidae*, were so crowded in the drawers that the specimens could not be moved in order to examine the labels without risk of injury to themselves and others. A large amount of Mr. Holland's time was therefore devoted to the rearrange-

ment and clear labelling of these congested sections of the Coleoptera. Mr. Holland has also been much occupied in helping in the researches which have been conducted in the Department, especially Miss C. B. Sanders' work upon the Burchell Brazilian butterflies (part of which is now in the press) and the Professor's work upon the large groups of mimetic butterflies captured by Dr. Richard Evans, D.Sc., Jesus College, in Siam in 1899. Both Mr. Holland and Mr. Hamm have always taken the keenest interest and given the most efficient help in all the researches which have been undertaken.

The need for a fresh consignment of cabinets—at least six months are required for construction—was brought before the Common University Fund, and £200 was granted for the purpose, £100 in 1903, £100 in 1904. The cabinets were made, as before, by Messrs. O. E. Janson and Son and delivered by road in good condition towards the end of the year. The space thus provided will be employed for the *Erycinidae* and *Lycaenidae*; while some of the sections of twenty drawers will be required to increase the accommodation at those points where growth has been most rapid in the parts of the collection already arranged. The immense advantage in the building up of cabinets by the superposition of similar twenty-drawer nests will now be apparent, for each congested part of the collection can be relieved by the intercalation of a fresh section, without in any way disturbing the arrangement of other parts where there is still room for growth.

An unusual amount of mechanical work has also been necessary during the past year. The large loft has been put into order and made available for the researches carried on by Miss M. E. Notley of Lady Margaret Hall, during the spring and early summer. The shelves erected early in 1903 by the Delegates of the Museum have been extremely useful. Both in the Hope Museum and Library great inconvenience has arisen from the penetration of fine dust caused by the masons' work upon the additions to the Chemical Laboratory.

As the collections have grown and the old specimens have been arranged in new cabinets with a due allowance of room for future increase, the floor of the Hope Museum has become more and more crowded, until it became necessary to provide space by moving cabinets out into the corridor. This method of relief—both inconvenient and undesirable in many ways—cannot be available for more than a short time, because the accommodation in adequately lighted parts of the corridors is very limited. Under these circumstances the Delegates of the Museum granted to the Hope Department the use of the south end of the large room vacated last July by the Radcliffe Library. Professor Townsend, however, found that he was in urgent need of the entire floor space; and the Delegates consented to meet his needs as well as those of the Hope Professor, by the erection of a commodious gallery for the insect cabinets. The necessary grants for its construction and for making a new door in the western end of the Hope Museum, giving easy access to the south end of the Old Radcliffe Library, were passed by Convocation, and the work carried out in the Long Vacation. The structure which has now been erected will be of permanent value when an Electrical Laboratory is built for the Wykeham Professor of Physics. The supporting standards of the gallery were carefully arranged with a view to the most economical and convenient employment of the floor space as the principal section of the Hope Museum. Advantage will be taken of the removal into the gallery to rearrange the whole of the cabinets in the Department—a rather serious undertaking.

The chaotic state of the partially catalogued Hope Library has for long been a source of trouble, causing much unnecessary waste of time, and often the entire failure to make use of opportunities for study which are on the spot but unavailable. In the autumn Miss Bellamy began work upon the library, marking the catalogued books and writing slips for the others. A great deal of work remains to be done, but a good beginning has been made. At the outset much kind

advice and help was given by Mr. F. A. Bellamy, of the University Observatory. A large amount of binding ought to be done at once. Not only are many gifts of important monographs made every year; but there is a vast accumulation of unbound volumes and papers dating from far beyond 1858, when the library was presented to the University by Mr. Hope.

Many hundreds of the unbound papers have been classified in the most convenient manner for binding in volumes, the arrangement requiring the expenditure of a large amount of time and thought. Colonel Yerbury, F.Z.S., very kindly came down to Oxford and stayed for some days, during which he classified the whole of the papers dealing with the Diptera. Mr. R. I. Pocock, F.Z.S., with equal kindness came to arrange those which treat of the Arachnida and Myriopoda.

A detailed account of the additions to the Departmental Library appears at the end of this Report. Special mention must be made of the three volumes containing the author's original drawings reproduced in the plates of "A Monograph of the Membracidae" (London, 1903), presented by the author, G. B. Buckton, Esq., F.R.S., F.L.S.; of the very valuable and extensive "Études d'Entomologie" presented by Monsieur Charles Oberthür, of Rennes, an abundantly illustrated series of volumes hitherto unrepresented in Oxford; of the splendid series of monographs by Professor Chr. Aurivillius of Stockholm, presented by the author; of the gift by R. I. Pocock, Esq., F.Z.S., of a complete set of his valuable memoirs upon the Arachnida and Myriopoda.

In the course of the researches which are published in his important monograph, Mr. Buckton studied many hundreds of Hope specimens and described a large number of types, thus rendering the University collection of the Rhynchota Homoptera of far greater interest and value.

One of the chief pieces of work in the preparation of fresh material during 1903 has been the completion of the setting and labelling of the large collection of insects made by the Professor, Mr. Holland, and Mr. Hamm in Majorca, near

Barcelona, and in the Eastern Pyrenees in June and July, 1901. A part of the Neuroptera has been already worked out by Mr. R. McLachlan, F.R.S., while Mr. Edward Saunders, F.R.S., has finished the majority of the Hymenoptera Aculeata and the Rev. F. D. Morice, M.A., Queen's College, the whole of the small collection of *Chrysididae.*

The principal part of the mechanical work upon the Balearic and Spanish collection was completed in 1902. As regards the splendid collection of butterflies from the neighbourhood of Lake Victoria Nyanza presented by Mr. C. A. Wiggins, F.E.S., the whole labour has fallen within the year 1903 and this has been the severest tax upon our resources. Out of about 12,000 specimens no less than 8,000 have been "set" and have received their printed locality labels. In order to prevent too complete stagnation in other directions, a large part of the setting of this consignment as well as the whole of many other small accessions have been entrusted to the skill and care of Mr. Arthur Cant, F.E.S., in London. Mr. Cant also reset and mended with great success several hundred butterflies captured by W. J. Burchell, Hon. D.C.L., in Brazil, between 1825 and 1830. The Department owes him a debt of gratitude for the great care with which the work has been done and for the feeling of confidence with which it is possible to regard specimens among which the transposition, displacement, or loss of the original labels bearing the handwriting of the great traveller would be an injury beyond repair.

Of course the General Collection will not absorb anything like the whole of these 8,000 British East African and Uganda specimens, but it was necessary to set them in order to provide material for the faunistic and bionomic researches of Mr. S. A. Neave, B.A., F.E.S., of Magdalen College. In the meantime large numbers are ready for cataloguing and incorporation, but are still kept apart in order that they may be conveniently studied by the generous donor when he returns to this country in the early summer.

Another very serious piece of work which has occupied

a large part of Mr. Hamm's time has been the double labelling, with names and localities, of the fine collection of British Diptera presented—worked out and complete—by Colonel J. W. Yerbury, F.Z.S., as well as the beautifully prepared specimens given by Mr. F. C. Adams, and the smaller collections presented by Mr. Hamm himself, Mr. Holland, and Dr. Jenkinson, D.Litt. Colonel Yerbury has also on many occasions assisted us by the determination of the species in these latter collections. Here in the University it is of the utmost importance to pay special attention to the British collections, and our gratitude is correspondingly deep when we receive so much kind help in material and in time and study as Colonel Yerbury has generously given us.

In speaking of the numerous researches which have been carried on in the Department or upon its material, the first place must be accorded to Dr. F. A. Dixey's ten years' work upon the *Pierinae*—the large group of butterflies represented in this country by the familiar "Whites," "Clouded Yellows," "Orange-tip," and "Brimstone." This great labour on behalf of learning and of the University reached its completion in the summer of 1903. The following brief account of the results attained has been kindly furnished by Dr. Dixey himself:—

"In 1893 the Pierinae in the Hope Collection occupied about 50 drawers; they were to some extent sorted out into genera and species, but the arrangement did not pretend to critical exactness, nor did it profess to represent the existing knowledge of the different species with their distribution and affinities. There were no labels except those in MS. attached to the individual specimens. These were often elaborate and written with much care; but they could not as a rule be read without removal of the specimen from the cabinet. The greater number of the species were grouped together, but several were detached from the general arrangement, and had to be sought in different parts of the collection. For reasons of this kind the difficulties in the way of making an effective study of the group were very great.

"At the present time the space devoted to the Pierinae consists of 5 cabinets of 60 drawers each—300 drawers in all. Each specimen has been carefully considered and placed in the position that may best illustrate its natural affinities and relation to conditions of locality and season. The genera and species have been indicated throughout by easily-read labels, and synonyms have been added when they possess special interest or importance. The order of the species within each genus, and of the genera within the sub-family, has been determined with the view of exhibiting the probable relationship of the various forms on a phylogenetic basis. With every genus and every species a map is given, coloured to show the present distribution of the particular assemblage on the earth's surface. Within the limits of each species the individual specimens are arranged geographically, according to a uniform plan; seasonal modification of forms, where it exists, is duly indicated by special labels. Every specimen, except a few for which no data exist, is accompanied by a label, generally printed, on which all available details of locality, date of capture, names of collector and donor, &c., can be read at a glance. The specimens belonging to such historical collections as those of Burchell, Belt, Bates, and Wallace can thus be readily identified, and every 'type' specimen bears a distinctive mark. In addition to the general collection there are also special series illustrating points of biological interest; for example, (1) the results of Mr. Marshall's valuable experiments on the epigonic relations of various forms of African *Pierinae*, and their reaction to diverse conditions of moisture and temperature; and (2) a series of forms of Indian *Catopsilia* relied on by the late Mr. de Nicéville to establish his view of their specific identity. These series, with printed data, are all inserted in their proper place under the general arrangement. In all parts of the collection, wherever a particular specimen has been figured or referred to in any published work, attention has been drawn to the fact and the reference given. In many cases MS. notes have been added."

It is not too much to say that, although a few other collections of *Pierinae* may be larger, there is no collection of this sub-family in the world which can afford so much real help to the student or inspire so many problems for research as that in the University Museum.

In the course of this ten years' labour Dr. Dixey has written many memoirs upon the *Pierinae*, or upon subjects suggested by them, such as Mimicry—Müllerian and Batesian. Separata of all these have appeared in the four volumes of the Hope Report. The last of these memoirs appeared in 1903, an interesting account of the Lepidoptera from the White Nile, presented to the Department by Mr. W. L. S. Loat, F.Z.S., together with further notes on Seasonal Dimorphism in Butterflies (Trans. Ent. Soc. Lond., 1903, p. 141).

Early in the year Mr. S. A. Neave, B.A., Magdalen College, began work in the Department as a preparation for African travel. The first part of Mr. C. A. Wiggins' splendid donation had arrived but a few weeks and had not yet been studied. The Professor suggested that Mr. Neave should work at this material, which came from probably the most instructive part of the continent, where, round the shores of Lake Victoria Nyanza, the fauna of the great western tropical forest meets and is interpenetrated by the fauna of the more open country on the east. Mr. Neave was soon deeply interested in the determination of species, the classification and the bionomic problems of Mimicry and Common Warning Colours. His projected journey fortunately fell through, so that when, later on, he was appointed as naturalist to the Surveying Expedition which the Chartered Company is sending to study for two years the country between the Zambesi and Lake Tanganyika, he started after a full year's work, including a large part of the vacations, spent in gaining a thorough knowledge of the forms he will now study in their natural environment. Just before sailing he received the proofs of his memoir, giving a list of all the species collected by Mr. Wiggins, and describing thirty new species or sub-species. A further paper on the bionomic problems he determined to write on the voyage.

The former will appear, by kind permission of the Hon. Walter Rothschild, in the Novitates Zoologicae of the Zoological Museum at Tring. Now that so much work is done in Oxford it is to be hoped that the University will consider the advisability of issuing a publication of its own.

During the past year much work has been done upon the great Burchell Collection presented in 1866 by the sister of the illustrious naturalist. A careful study has been made of the three manuscript note-books—two relating to Brazil (1825–30) and one to South Africa (1810–15)—without which the collections would lose much of their value. These note-books contain the record of hundreds of unpublished original observations made by a great and accurate observer. To give a single example, it was found that Burchell had noted on Dec. 3, 1828, when at Porto Real (now Porto Naçional) on the Tocantins River, Brazil, that a scorpion denoted by the reference number 1247 "makes a noise between a hiss and a whistle with its pectiniform appendages." Mr. R. I. Pocock, F.Z.S., the authority upon scorpions, who has made a special study of their sound-producing organs, was shown the note and expressed the opinion that Burchell was mistaken; for (1) no American scorpion was known to produce a sound, (2) no scorpion of any kind was known to make use of its pectiniform appendages for this purpose. The collection was searched, and the scorpion bearing the number 1274 was found by Mr. Holland. It was submitted to Mr. Pocock, who identified it as *Rhopalurus borellii*, one of his own species, only described in 1902! Guided by Burchell's note, Mr. Pocock then examined the pectines and the area beneath them, and at once found a new sound-producing organ which he has described and figured (Ann. and Mag. Nat. Hist., 1904, p. 56, Plate IV). Burchell's specimen and note-book also cleared up the existing uncertainty as to the precise locality of the species.

This is but one example to show what a mine of wealth the University possesses in the note-books combined with the collection. The immense size of the latter exposes the note-

books to some risk. Burchell estimated his Brazilian insects at from sixteen to twenty thousand; and the amount of reference which this number implies ought not to be thrown upon the original manuscript, which is a priceless possession. Will not some friend of learning and of Oxford have an exact copy made, or, far better, have the original printed and issued to scientific libraries as a small volume of Hope Reports? Then, as each paper appears, describing some part of the great collection, every naturalist could compare it with an authentic copy of the geographical notes, dates, and records of observation made by the naturalist whom Oxford honoured with the degree of D.C.L. in 1834.

The work which has been done upon the Burchell Collections during 1903 was published at the beginning of the present year in the Annals and Magazine of Natural History. The publishers have kindly consented to an arrangement whereby all such papers are repaged, printed off in sheets, and stored, so that ultimately one or more volumes of Hope Reports will be issued dealing exclusively with the Burchell Collections. There have appeared at present (1) An introductory account of the life and travels of W. J. Burchell, by the Professor (p. 45), with a map showing his Brazilian route, prepared by Miss Cora B. Sanders, of Lady Margaret Hall; (2) The account of a new stridulating organ in scorpions, by Mr. R. I. Pocock, F.Z.S. (p. 56); (3) A memoir on the Malacoderm beetles, both African and Brazilian, by Monsieur Jules Bourgeois of Ste-Marie-aux-Mines [Markirch], Alsace (p. 89). This latter includes the description of four new species, including *Chlamydolycus burchelli*, captured Nov. 18, 1813, at Uitenhage, Cape Colony, and *Celetes burchelli*, captured at 10 P.M. Dec. 18, 1826, on the Sierra da Cubatão, Brazil. The priceless value of Burchell's notes will be appreciated by the study of this paper, which abounds in observations upon the habits, and mode and time of display of light by various species of "glow-worms" and their larvae. (4) An account of the Brazilian butterflies of the sub-families *Ithomiinae*, *Danainae*, and *Satyrinae*, by Miss

Cora B. Sanders (now in the press). In this latter paper, in the production of which Dr. F. D. Godman, Hon. D.C.L., F.R.S., Mr. W. Holland, and the Professor have also co-operated, some evidence will be brought forward which suggests that slight changes have taken place in certain forms during the lapse of three-quarters of a century.

In the Easter Vacation the Professor took the opportunity of a visit to Paris to carry by hand the fragile Malacoderm beetles collected by W. J. Burchell, together with other Malacoderms; and these were very kindly taken on to Alsace by Monsieur Bourgeois' brother. The Burchell specimens were subsequently returned to Paris in the same manner, and brought back to Oxford by Miss Poulton in June. Not the slightest injury was caused. On the same visit the Professor made a communication to the "Société Entomologique de France," on April 22: "La signification bionomique des taches ocellaires des phases de la saison humide chez les Satyrinae et Nymphalinae"[1].

The preparation for further memoirs continues. The whole of the Burchell Brazilian *Hesperidae*, having been "reset," are now in the hands of Dr. Godman, who has kindly promised to work them out. Colonel Bingham has also kindly named the specimens of the ants, of which there are many and deeply interesting records in the note-books.

In writing the Introduction it was necessary to consult Burchell's letters preserved in the Herbarium at Kew, as well as the note-books which refer to his vast botanical collections. Every facility and the kindest help was always afforded on these occasions. Sir Joseph Hooker, one of the few naturalists who remembers Burchell, has with the utmost kindness written again and again and afforded important information which could have been gained from no other source.

Mr. Edward Saunders, F.R.S., who has rendered such invaluable aid for so many years, has during 1903 completed the determination of the species in four out of the twelve large boxes of Greek Hymenoptera collected by his cousin,

[1] *Ann. de la Soc. Ent. de Fr.*, p. 407, Dec. 1903.

Sir S. S. Saunders. He has also almost finished working out the large collection of Majorcan, Spanish and E. Pyrenean Hymenoptera Aculeata made in 1901, and has published an account of the small collection of Aculeates from Tenerife and Madeira (Trans. Ent. Soc., 1903, p. 207); kind aid was also afforded by Monsieur Auguste Forel of Morges, who named the Madeiran ants submitted to him for the Hope Department by Mr. Edward Saunders. The Hemiptera, in the last two collections, have also been kindly named by Mr. Saunders. The Majorcan Aculeata and Hemiptera, when completely worked out, will be published as a most interesting paper throwing great light upon the comparatively neglected Balearic insect fauna.

The experimental inquiry into the struggle for existence during the pupal stage of *Vanessidae*, begun in 1898, and continued in 1899, was resumed by Miss M. E. Notley during the past summer, aided by a grant from the Government Grant Committee of the Royal Society. While waiting for material in the early part of the unusually backward season Miss Notley began an investigation into the influence of darkness and light upon the behaviour of caterpillars. This work, and the first portion of that upon the pupae, was undertaken here, the larvae being reared in the Department and the pupae exposed on trees, hedges, fences and nettle-stems in the north of Oxford. Miss Cora B. Sanders of Lady Margaret Hall took the keenest interest in the whole of the work done in Oxford, and at all times rendered the most efficient assistance. During the Long Vacation Miss Notley continued the inquiry at St. Helens, Isle of Wight. The whole of the results obtained in 1898, 1899 and 1903 will be ready for publication in a few weeks.

Mr. R. Shelford's important paper "On Some Mimetic Insects and Spiders from Borneo and Singapore" (Proc. Zool. Soc., 1902, Vol. II, p. 230), although belonging to the publications of the previous year, did not appear until 1903. Almost the whole of the large amount of material upon which this memoir is based has been placed by the generosity of the author

in the Hope Department, where it can be studied by all naturalists interested in bionomic questions. The paper itself is by far the most important publication dealing with Oriental insect bionomics which has appeared since Alfred Russel Wallace's classical monograph on the Malayan *Papilionidae* (Trans. Linn. Soc., Vol. XXV, p. 1, 1868).

A paper describing his first research in the Department, undertaken in 1893, was published by the Professor (Trans. Ent. Soc., Lond., 1903, p. 311). The delay was occasioned by the drawings and manuscript having been mislaid during the alterations to the Department in 1894. The experiments, in which Mr. Holland rendered the most valuable assistance, proved that an environment of lichen-covered bark produces the most remarkable effect upon the colours of certain caterpillars.

The third volume of Hope Reports dealing exclusively with African Zoology, issued early in the year 1903, was described in the Report for 1902. Later in the year (Nov. 9) the fourth volume appeared, containing a variety of memoirs which were published between the years 1900–1903. It includes eleven papers dealing with insect bionomics and other questions relating to evolution and natural selection in this group of animals, by the following writers:—Mr. Nelson Annandale, B.A., Balliol College; Dr. F. A. Dixey, D.M., Wadham College; Mr. R. Shelford, M.A., Curator of the Sarawak Museum; Mr. Guy A. K. Marshall, F.Z.S.; and the Professor. The volume also contains eight papers dealing with systematic and faunistic questions by the following authors:—Mr. W. L. Distant; the Rev. O. Pickard-Cambridge, F.R.S.; Mr. S. A. Neave, B.A., Magdalen College; Mr. Edward Saunders, F.R.S.; Col. J. W. Yerbury, F.Z.S.; and the Professor.

The foregoing statement is very far from completing the record of the help received from kind friends of the Hope Collections. The staff of the Insect Department of the British Museum of Natural History have, as in previous years, rendered the most valuable assistance, and the Professor has

in turn been enabled to help them by taking types to London for study and comparison.

The Rev. G. Dexter Allen, M.A., Non-Collegiate, kindly helped in the arrangement of the Coleoptera by undertaking the identification and classification of the *Cicindelidae*. He had made considerable progress in this valuable piece of work when he was compelled to sail for Borneo.

In addition to the kind help with the Majorcan *Chrysididae* the Rev. F. D. Morice has also named the British species of this family—previously in a state of confusion, without trustworthy determinations, and useless for the purposes of study or reference.

Col. C. T. Bingham very kindly named a set of Australian Aculeates and described several new species in a paper soon to be published. Col. Bingham also assisted the Department on many other occasions by determining species of the Oriental Hymenoptera upon which he is so distinguished an authority.

Mr. Hamilton H. Druce, F.Z.S., has added to the kind help he has rendered for many years by giving advice and assistance in making out the most obscure and difficult of the African *Lycaenidae* and *Hesperidae* presented by Mr. C. A. Wiggins. He has also described a beautiful new Hesperid from Kitui, British East Africa, presented by Mr. and Mrs. S. L. Hinde. This species has been named after the captors, *Leucochitonea hindei*.

Mr. W. J. Lucas has kindly named the British dragon-flies which have been received since his arrangement of the collection of these Odonata, and has also determined some other British Neuroptera.

The Rev. H. S. Gorham has rendered the most valuable help with several groups of the Coleoptera—the *Cleridae*, *Endomychidae*, *Erotylidae* and *Coccinellidae*. Mr. Gorham's determinations were made in part during a visit to Oxford in the summer, and in part at home, where he had the opportunity of comparing the Hope specimens with his private collection.

The contemplation of the vast mass of unarranged, unnamed material in the Hope Department, and a consideration of the

limited means for dealing with it which alone are possible for the University, lead at times to a feeling of depression. When each year the time comes for these Reports to be written this attitude gives way before one of hopefulness, even of confidence, inspired by the thought of the large amount of kind and willing help freely given by the most eminent authorities upon Insect Systematics.

Additions to the Collections in 1899.

Ten Coleoptera, chiefly *Brenthidae*, from Kuching, Sarawak (1899), were presented by R. Shelford, Esq., M.A., Christ's College, Cambridge.

Forty-two Lepidoptera and two scorpions, from various localities in Mexico (1897–8), were presented by O. H. Howarth, Esq., together with a *Colias* from El Paso, Texas (1898).

Additions to the Collections in 1900.

Fifty-six Coleoptera from Kuching, Sarawak (various dates), presented by R. Shelford, Esq., M.A., Christ's College, Cambridge, have been catalogued. The series includes a co-type of *Diurus shelfordi*, described by Dr. A. Senna of Florence, and many interesting Longicorns of the genus *Oberea*, mimetic of Hymenoptera.

Three insects from Pankalan Ampat, at the base of Mount Penrissen, Borneo (May, 1899), figured in Proc. Zool. Soc., 1902 (Plates XX, Figs. 31, 39; XXII, Fig. 7), together with two *Endomychidae* from the same locality, were presented by R. Shelford, Esq., M.A., and E. A. W. Cox, Esq.

Twenty Coleoptera from Virginia, U.S.A. (June, 1900), and one from Niagara (July, 1900), were presented by the captor, Ralph D'A. Morrell, Esq.

A hundred and four Coleoptera (chiefly Phytophaga) from various localities, principally the southern part of the Bombay Presidency (1885–95), were presented by H. E. Andrewes, Esq., and Dr. F. W. Andrewes, D.M., Christ Church. The collection includes seven co-types of Herr M. Jacoby, one of Horn, and one of Régimbart.

Additions to the Collections in 1901.

Eighty-six Lepidoptera from various localities in Greece and eighty-two from Switzerland (Uri and Ticino) were presented by the captor, W. M. Geldart, Esq., M.A., Trinity College. All the specimens were captured in 1901. The dates and localities are full and precise, rendering the accession of great value. The specimens from Greece are especially welcome, the collection being very deficient in Lepidoptera from South-Eastern Europe.

Six Coleoptera and one Mantis (*Hymenopus bicornis*) from Kuching, Sarawak (1900–1), were presented by R. Shelford, Esq., M.A., Christ's College, Cambridge.

Two hundred and ninety-four Geometrid moths and one Saturniid from tropical America (various localities and dates) were presented by W. Schaus, Esq., F.Z.S. All the specimens are named by the donor, and there are very nearly as many species as individuals, so that the collection will be of the highest value in the naming and arrangement of this important section of the American moths.

An interesting set of seven *Blattidae* and three Lycosid spiders, accidentally introduced into the Avonmouth Dock at Bristol (April, 1901), were presented by G. C. Griffiths, Esq., F.Z.S. The specimens, which came over from Jamaica with bananas in the "Port Morant," were taken alive in the Dock. They form a most interesting addition to the part of the collection which illustrates the means of distribution of Arthropod animals.

A set of 110 Lepidoptera, especially wanted as an addition to the section of the bionomic series dealing with mimicry and common warning colours, was purchased from Messrs. Watkins and Doncaster. The groups from South America, the classical ground for the study of these interesting problems, are particularly fine. The series also includes some excellent examples from tropical West Africa and a pair of the fine Danaine butterfly from Madagascar (*Amauris nossima*).

Additions to the Collections in 1902.

Since the last Report a great deal of work has been expended upon the accessions of this year, and a large number of specimens have been now catalogued and incorporated.

An interesting collection of 232 insects of many groups from Tenerife (1902) was presented by the captor, F. A. Bellamy, Esq. The Hope Department contains fine collections from the Atlantic Islands made by the late T. V. Wollaston about fifty years ago, so that it is particularly interesting to obtain fresh material from any of these localities, especially when the data are as exact and detailed as those supplied by Mr. Bellamy. Hearing that my friend Mr. Edward Saunders, F.R.S., was preparing a paper on the Hymenoptera Aculeata collected by the Rev. A. Eaton in Madeira and Tenerife, I induced him to work out Mr. Bellamy's specimens of this group, and at the same time sent him Wollaston's Madeiran Aculeates. The ants in the latter series he submitted to Professor Forel. The paper was published in the Trans. Ent. Soc, Lond., 1903, pp. 207–218, with a supplementary note on p. 551. With regard to the Wollaston specimens, Mr. Saunders remarks: "It is important to record, as far as possible, the forms which existed half a century ago in an island so liable to accidental immigration as Madeira." There were no new species in Mr. Bellamy's collection of Aculeates, although several are of great interest. Chief among these are the queens, not obtained by Mr. Eaton, of the Tenerife form of *Bombus terrestris*. A black humble-bee with the apex of the abdomen snowy white, from the Canary Islands, had been identified by Brullé as *Bombus soroensis*. Professor Perez of Bordeaux (1894) and Mr. Saunders (independently in 1903) came to the conclusion that the insect is a variety of the well-known *Bombus terrestris*, with a very unusual and remarkable coloration. Should any friend of the Department be visiting the Canary Islands, the Professor would be extremely glad to receive humble-bees from Grand Canary and any of the other islands except

Tenerife, from which, through the kindness of Mr. Bellamy, the collection is well supplied with these insects.

Sixty-two Lepidoptera and one Dipteron from the Thoungyin Valley, Lower Burma, were presented by Herbert Druce, Esq., F.L.S. The locality rendered the specimens of much value, and many of the insects, especially the *Pierinae*, were also greatly wanted as species.

A splendid collection of Hymenoptera Aculeata from the Orange River Colony and Natal was presented by the captor, F. N. Brown, Esq. All the specimens are now provided with printed labels, but the cataloguing is deferred until they are named. They are now in the hands of Colonel Bingham, who has kindly promised to work them out at the first opportunity.

Forty-seven insects of various groups from many localities in South Africa were also presented by F. N. Brown, Esq.

A hundred and ninety-nine butterflies and one moth from Llabisa, East Central Zululand (1902), were presented by Champion B. Russell, Esq., M.A., University College. The specimens were collected by Mrs. Peachey in a locality which renders them of much value to the collection, and there were also many greatly wanted as species. A beautiful group of synaposematic Acraeinae (three species) has been added to the bionomic series.

Three Muscid flies, allied to the genus *Bengalia*, together with their puparia, were presented by Guy A. K. Marshall, Esq. The larvae were extracted from a dog at Salisbury (1902).

The large and valuable collection of South African insects presented by Guy A. K. Marshall, Esq., have been supplied with printed labels with the exception of a fine set of butterflies from Natal, which are now being "set" in London. Of the labelled specimens, 966 are catalogued and the great majority incorporated, the remainder being kept together for further study. Numerous Aculeates and a fine collection of Diptera will be numbered after they have been worked out. The catalogued collection includes the following:—

Three Lepidoptera showing injuries, probably caused by the

attacks of birds; from Melsetter, Gazaland, S. E. Rhodesia (1901). In one of these cases Mr. Marshall saw the moth (a conspicuous Hypsid, *Calloratis bellatrix*) seized and immediately dropped by a young and probably inexperienced Drongo. The moth has lost most of its head (Trans. Ent. Soc., Lond., 1902, pp. 358–9).

A beautiful group of 16 black white-marked butterflies captured by Mr. Marshall in a single day (Nov. 18, 1901) in the forest at Mt. Chirinda, Melsetter (about 4,500 ft.). Mr. Marshall considers that these contrasted tints are especially adapted for conspicuousness in the shade of the forest. The central members of the group are two species of the Danaine genus *Amauris* (4 *A. ochlea* and 3 *A. dominicanus*), and round these are ranged 5 species of *Nymphalinae* belonging to the 3 genera *Neptis*, *Pseudacraea*, and *Catuna*; 3 species of *Acraeinae* (including the beautiful *A. satis*, new to the Collection); and one of *Pierinae*.

Another group of 8 specimens from the same locality captured by Mr. Marshall (Nov. 27 and 28) is similarly convergent towards the buff-marked black species of *Amauris* (2 *A. echeria*, 2 *A. lobengula*).

The following sets of models and mimics (in many cases captured on a single day by Mr. Marshall) and synaposematic groups from Gazaland (Nov.–Dec. 1901, and Jan. 1902) and, unless otherwise stated, from Mt. Chirinda:—Four Dipterous mimics with their Aculeate Hymenopterous models. One of these, a beautiful Asilid mimic of a Xylocopid bee was captured on the Inyanyadzi River (Dec. 20, 1901). Another very fine Asilid mimic of a Fossor of the genus *Salius* (in this case captured a day later) was itself devouring a small Aculeate at the time of capture (Dec. 12, 1901).

A Longicorn beetle with its probable Ichneumonid model.

A set of 5 Ichneumonidae of more than one species with iridescent blue-black wings, resembling each other in the possession of a transparent window in a sub-apical position in the forewing.

Nineteen insects (Hymenoptera, Hemiptera, Lepidoptera,

Coleoptera) forming a group characterized by a type of colouring common in African Lycid beetles.

Eighteen Coleoptera forming a group with a cantharid type of colouring and transitional into a common Phytophagous type.

Sixteen Coleoptera with another type of colouring common in Phytophaga, viz. iridescent blue-black elytra, thorax and head yellowish.

Fourteen synaposematic Coccinellid Coleoptera.

In addition to these interesting groups Mr. Marshall presented 143 insects of various orders from Mt. Chirinda, for the systematic collection. The locality is of much interest inasmuch as it represents an isolated remnant of the primitive tropical forest; and Mr. Marshall observed that the insect fauna is in many respects different from that of the other localities in Mashonaland over which he has collected.

Also from the Mpudzi River, Manica, E. Rhodesia (about 3,000 ft.) 43 insects of various orders, all captured by Mr. Marshall in November and December, 1901.

From Salisbury, Mashonaland (5,000 ft.) a large number of specimens of the highest interest, mostly captured in 1902: three specimens of *Precis antilope*—a wet-phase parent and its two dry-phase offspring—were described in the Report for 1902, although then uncatalogued. These historic specimens, proving for the first time (April 1902) that *P. simia* is but the wet form of *P. antilope*, are described in Trans. Ent. Soc., Lond., 1902, p. 418, and figured on Plates XII, XIII.

Three butterflies with injuries, probably caused by the attacks of enemies (one captured by Mr. H. Dobbie).

Eighteen Coleoptera of Cantharid type of colouring passing into a common Phytophagous type.

Sixteen Coleoptera and one Bracon with Lycoid colouring. Two ant-models, each with a Staphylinid mimic, *Poecilomorpha mutillaria*, a Coleopterous mimic of a Mutillid.

A Scoliid with its Sesiid mimic.

Nineteen examples of the Coleoptera employed in Mr. Marshall's experiments on the taste or smell of insects as

a means of defence against their enemies (Trans. Ent. Soc., Lond., 1902, p. 287).

A beautiful Reduviid with a complex pattern common to other Hemiptera (l. c., Plate XIX, Figs. 48–52).

Two Fossorial Hymenoptera of the genus *Ammophila* with two examples of a beautiful Dipterous mimic, all captured on the same day (Feb. 23, 1902); a similar pair taken Mar. 16. Another Hymenopterous model with its Dipterous mimic (Jan. 19), and a second example of the mimic, captured at a different date. Two such models and a Dipterous mimic captured on Jan. 26.

Two Ichneumonids and six Diptera characterized by the possession of a transparent window sub-apically placed on the dark wing.

Nine iridescent black red-marked Staphylinid Coleoptera, together with examples of the Neuropterous family *Embiidae* with a similar colouring and pattern. The whole group is deeply interesting.

Three Asilid flies with their prey. The examples indicate in a striking manner the aggressive character of these Diptera; for one was devouring an *Ammophila* (Aculeate Hymenoptera), one a *Lagria* (Heteromerous Coleoptera), and one a Dragon-fly. The two latter instances have been recorded (l. c., p. 334).

A Dipterous parasite (*Anthrax*) with its puparium, bred from the mud cells of a species of *Chlorion*, together with two examples of the Aculeate which emerged from other cells of the same set.

Three Dipterous parasites (*Tachinidae*) bred from the larva of *Acherontia atropos*.

A parasite from a bat (*Miniopterus schreiberis*) and from a kestrel (*Cerchneis naumanni*). Another bird parasite (host unrecorded).

In addition to the above specially mentioned accessions, 487 insects of various Orders from the neighbourhood of Salisbury have been incorporated. These include a valuable set of 91 Lycid beetles (some from Natal), of which the species have been very kindly determined by Monsieur Jules

Bourgeois of Ste-Marie-aux-Mines, Alsace. The collection is all the more valuable because the capture of many paired specimens is recorded.

Fifty-eight specimens of various Orders from Umtali, Mashonaland (3,700 ft.), in part captured by Mr. Marshall and in part by Mr. H. Dobbie, at various dates. One butterfly, a *Charaxes*, exhibits injuries probably due to enemies.

From the Umfuli River, Gadzima, Mashonaland (4,200 ft.), a tsetse-fly (*Glossina morsitans*), 2 beetles with Lycoid colouring, 2 Buprestid beetles with Cantharid pattern, all captured by Mr. Marshall, Nov., Dec. 1895.

From Uitenhage, Cape Colony, Mr. Marshall presented 7 Coleoptera captured by the Rev. J. O'Neil.

A hundred and twenty-seven butterflies and one moth from N. Providence Island, Bahamas, were presented by C. V. A. Peel, Esq. The insects were captured in 1901, chiefly in the grounds of Government House, Nassau, by H. S. Gladstone, Esq. The butterflies include a fine series of *Papilio bonhoutii*. The locality renders the whole collection of much interest and value.

The large collection of insects of various Orders made in Central Spain by the Professor in July 1902, has now been labelled and catalogued. It consists of 1,217 specimens, of which the great majority were captured by the donor at La Granja (San Ildefonso) in the Sierra Guadarrama (4,000 ft.), a few at El Escorial in the same range, at Madrid, Segovia and Burgos. A considerable number were taken at much higher elevations (up to 7,700 ft.) on Peñalara, the mountain behind La Granja. Near the summit the northern grasshopper, *Gomphocerus sibericus*, was found swarming, and specimens illustrating observations on the habits of various insects were obtained. The collection includes many butterflies apparently injured by the attacks of birds, the injury being in many instances noted before the insect was captured. In the Palace grounds, at La Granja, birds were extremely abundant, and here even freshly emerged butterflies were more frequently notched and torn than observed elsewhere

in Europe. In some cases the rejected wings were found lying upon the ground. Five groups captured in one spot on the same day exhibited a synaposematic tendency in European beetles, the members of the specially protected groups possessing a similar conspicuous colouring, and exposing themselves in a similar manner on flower heads, grass-stems, projecting twigs, &c. A special study was made of the predaceous flies of the family Asilidae, and the courtship of one species, *Dasypogon diadema*, was observed on several occasions. With these fierce and powerful females courtship is nearly as dangerous as it is in many spiders. One female, *D. diadema*, was captured in the act of devouring the male of its own species; and it is possible to understand why the males seem especially eager to court females which are engaged in eating other insects. Much light was also thrown upon the preferences of these and other species of Asilidae for particular kinds of insect prey. *Diadema* was captured devouring the hive-bee on many occasions, and the Hymenoptera generally suffered more than other insects from these attacks. It is hoped that a systematic account of this and other material bearing upon the struggle for existence will be published at no distant date.

Twenty-two insects of various Orders from La Granja (July, 1902) were presented by the captor, Mrs. E. B. Poulton.

Six insects, including *D. diadema* and its prey, from La Granja (July, 1902) were presented by the captor, Monsieur Chretien.

An extremely valuable gift has been presented by R. Shelford, Esq., M.A., Christ's College, Cambridge, Curator of Rajah Brooke's Museum at Kuching, Sarawak: viz. the great majority of the specimens represented in the 156 figures on Plates XIX–XXIII of the Proc. Zool. Soc., 1902, including 10 types or co-types of new species. These specimens, illustrating Mr. Shelford's interesting memoir on "Mimetic Insects and Spiders from Borneo and Singapore," will be kept together, arranged as in the Plates. Full references have already been printed for all of them. 115 of these figured specimens

were presented in 1902, in addition to several others in earlier years. For a museum which specializes so largely upon bionomic questions this donation is of the highest importance. Of almost equal interest is a collection of 166 Bornean insects illustrating bionomic principles. Many of these are the specimens mentioned by Mr. Shelford in the same memoir, and sent over for exhibition when it was read. They include a beautiful series of mimetic Longicorn beetles chiefly of the genus *Oberea*, together with their models, the black-winged *Braconidae*; another series with their models, the bronze-winged *Braconidae*. A beautiful example of a mimetic Longicorn with its Curculionid model, the association comparing in the most interesting manner with some of Mr. Marshall's groups from South Africa: *Anthribidae* and their Longicorn mimics *Ereis* and *Cacia*; *Erotylidae* and *Endomychidae* with similar, probably synaposematic, patterns and colours; a small *Mantispa* and its Hymenopterous model (both from Singapore); Hemiptera (*Reduviidae*) synaposematic with *Braconidae*; Diptera mimetic of Hymenoptera; a remarkable mimetic association between a Homopterous insect and a Lithosid moth (*Darantasia*); a beautiful red-banded Sesiid moth mimetic of an Aculeate; additional specimens of many groups illustrated in Plates XIX–XXIII, P. Z. S., 1902; a group, probably synaposematic, of strongly spined beetles of the genus *Amphisternus* with possible mimics; specimens of the Longicorn mimic *Zelota spathomelina*, Gahan (co-types) and its Endomychid model, *Spathomeles*, sp. near *turritus*; a large and beautiful synaposematic group of many species of glossy brown Phytophaga (*Galerucidae*) and their Longicorn mimics; a fine set of Bornean butterflies exhibiting injuries probably caused by the attacks of insect-eating animals; a set of spined *Hispidae* kindly named by Dr. R. Gestro of Genoa, including a co-type of *Platypria chaetomys*, Gestro; conspicuous Coleoptera of species which had been rejected by insect-eating animals. Nearly the whole of this invaluable and most instructive collection was made in the neighbourhood of Kuching, many

on Mount Matang, a few at Trusan, at Paku, at Santubong, and at Singapore. The kind help afforded by many eminent specialists in working out the collection has been gratefully acknowledged in the earlier part of this Report and in that of the year 1902; as also in Mr. Shelford's paper in the Proc. Zool. Soc., 1902 (p. 231).

A hundred and eleven insects of many Orders, from Bilderlingshof on the Gulf of Riga (1902), were presented by the captor, H. H. Druce, Esq., F.Z.S., F.E.S. The gift is especially welcome, inasmuch as Russian localities have been hitherto almost unrepresented in the Department.

Valuable collections of insects of several Orders and a few other Arthropoda from European districts as yet unrepresented in the Department have been presented by the captor, E. Lorenz Meyer, Esq., of Hamburg; from the Island of Sylt, Schleswig (Aug. 8, 1902), 45 specimens; from Füssen in Upper Bavaria (July 24–29, 1902), 66 specimens; from Worishofen, near Munich (July 1–15 and 16–22, 1902), 276 specimens. Thus nearly 400 specimens, with excellent data, have been added to our European collection. The fine series of individuals of several species of Fritillaries (*Argynnidae*) are especially welcome, but the whole collection supplies an important place which has been hitherto almost empty. It is hoped that Mr. Edward Saunders, F.R.S., who has been so kind a friend to the Department, will name the Aculeata and Hemiptera of this and Mr. H. H. Druce's collection, together with a few others from Northern Europe captured by the Professor in 1901.

Seventy-seven insects of various Orders, chiefly Coleoptera, collected in the neighbourhood of Blockhouse No. 74, on the Valsch River, near Bothaville, Orange River Colony (1902), were presented by the captor, E. N. Bennett, Esq., M.A., Hertford College.

Nine specimens of various Arthropoda from Estañcia do Rey, Mercedes, Uruguay, were presented by Mrs. E. S. Craig. In addition to three Arachnida, the specimens include an extremely fine Fossorial Aculeate, Coleoptera, and Mantidae.

The locality renders all the species of much interest and value to the collection.

The following valuable donations presented by Herbert Druce, Esq., F.L.S., have now been set, labelled, and catalogued :—

A hundred and thirty-one butterflies and ten moths collected by J. Carder in the interior of Colombia (about 1896).

Twenty-six butterflies collected by Watkins on the Rio Perene, Peru (about 1902).

Thirty-one butterflies collected by T. Alexander and M. Eder on the Rio Caqueta on the south-east boundary of Colombia.

Twenty-four insects, chiefly butterflies, collected by Hamilton in the Khasia Hills, Assam (about 1895).

Six fine *Anthribidae* (Coleoptera) collected by A. Steffen, Esq., in Langsuan State, Lower Siam (1899–1902), were presented by N. Annandale, Esq., B.A., Balliol College.

PURCHASES.

The following specimens were purchased in 1902. Eighty-seven Lepidoptera collected, 1901, at Chanchamayo, La Merced, Peru, and 63 from the Upper Rio Toro in the same province (1901), were purchased from Mr. W. F. H. Rosenberg. The specimens were much wanted in the collection, which is very weak in Western tropical American forms, while many of the specimens showing interesting mimetic or synaposematic association were placed in the bionomic series.

Three hundred and twenty-four Lepidoptera and three Homoptera from British New Guinea (between Holnicote Bay and the German boundary, August, 1900, to March, 1901) were purchased from the collector, Mr. H. S. Rohu. The Hope Collection is particularly poor in specimens from New Guinea, and many of the species were hitherto unrepresented at Oxford. A few mimetic, or more probably synaposematic, groups of butterflies were added to the bionomic series.

Additions to the British Collections in 1902.

A valuable series of 508 insects and one Myriopod, from localities in the neighbourhood of Oxford, was presented by the captor, Mr. W. Holland, of the Hope Department. All are most welcome, but the collection of 343 Diptera, all of which have been named by Colonel Yerbury, are particularly valuable. The dragon-flies include the following rare species, captured at King's Weir:—Three *Gomphus vulgatissimus* (rare in spite of its name), 3 *Agrion pulchellum*, 1 *Erythromma nais*. Six specimens of each of two closely similar but distantly related Coleoptera, the Malacoderm *Rhagonycha limbata* and the Longicorn *Tetrops praeusta*, obtained together from hawthorn, are an interesting addition to the British bionomic series.

Fifty-eight insects of various groups from the neighbourhood of Oxford and from South Devon were presented by the captor, Mr. A. H. Hamm, of the Hope Department. An Empid fly with its victim, another Dipterous insect, from the Park (1892), has been added to the bionomic series. The insects from Devonshire included a specimen of *Vanessa polychloros* from Bovey Tracey (August 12, 1902), for the bionomic series. As the butterfly rested upon a flower, Mr. Hamm noticed that both hind wings had been injured, probably by the attack of a bird. In such cases the record of the observation of an injury previous to capture lends much additional value to the specimen.

Four insects from the University Museum or its grounds, and nine from Charney, near Wantage (all 1902), were presented by the captor, Mr. H. Trim, of the Oxford University Museum.

Seven Diptera and Hymenoptera, from the neighbourhood of Oxford (1902), were presented by the captor, W. G. Pogson Smith, Esq., M.A., St. John's College; and 11 specimens of insects of various Orders, also from Oxford (1902), were presented by the captor, J. E. Pogson Smith.

Eight insects of various groups from the neighbourhood of

Oxford; 36 from St. Helens, Isle of Wight (including the rare Aculeate, *Nomada armata*); and 33 from Burley, New Forest (all 1902), were captured and presented by the Professor.

A Hymenopterous parasite bred (1902) from the larva of *S. cynipiformis*, from Bagley, was presented by W. M. Geldart, Esq., M.A., Trinity College.

A fine series of additions to the British Collections from Herefordshire (1902) were presented by the captor, Col. J. W. Yerbury. This important accession includes 317 Coleoptera, 253 Rhynchota, 2 Hymenoptera, and 2 Orthoptera.

Two specimens of *Eupithecia rectangulata* bred from apple, 4 Tortrices and 18 Tineidae bred from pear, from the garden of Airedale, Canterbury Road, Oxford, were presented by the Rev. H. Adair Pickard, M.A., Christ Church, together with 3 parasitic Braconidae which emerged from some of the above larvae.

Additions to the Collections in 1903.

The chief donations during the year remain uncatalogued—that of C. A. Wiggins, Esq., of Nairobi, British East Africa, which is kept apart in order that the donor may see it as a whole; and that of A. H. Harrison, Esq., which only arrived towards the end of the year.

A series of 19 butterflies was presented by J. A. Gibbs, Esq., M.A., Keble College. Although without recorded data, there is no doubt that the species represented in the collection came from Ecuador, Bolivia, or Peru. The condition of the specimens is unfortunately not very satisfactory. All were greatly wanted in the collection.

Four specimens of the Dipterous insect *Hippobosca maculata*, from Trinkomali, Ceylon (1890–91), were presented by Col. J. W. Yerbury, the captor of all but one. Col. Yerbury also presented five specimens of *Hippobosca camelina*. The specimens were taken from a camel at Skaik Othman, Aden, on March 4, 1895, by Col. Yerbury.

Sixteen butterflies and three Neuroptera from the neighbourhood of Urmi, N.W. Persia (1903), were presented by

the captor, Arthur Longdon, Esq.; and a moth of the genus *Catocala*, from the same locality (1902), by the captor, L. N. Heazell, Esq. The specimens were very welcome on account of the great interest of the locality.

Eleven insects from the Zeerust District of the Transvaal (Feb. 1901) were presented by the captor, Trooper E. Hamm. They include four specimens of *Limnas chrysippus*, much wanted for the sake of the locality.

A muscid fly, allied to the genus *Bengalia*, together with its puparium, was presented by George F. Leigh, Esq., F.E.S. The larva had been extracted from the leg of a child at Durban, on Feb. 2, 1903; it pupated Feb. 5, and the fly emerged March 1. This interesting example of a dipterous insect which attacks man is now being studied by Mr. E. E. Austen in the British Museum.

A valuable collection of insects from the Siamese States has been presented by the collectors, N. Annandale, Esq., B.A., Balliol College, and H. C. Robinson, Esq. The collection is an important part of the material described in "Fasciculi Malayenses" (Liverpool University Press), edited by Mr. Annandale and Mr. Robinson. The collection consists of 269 butterflies, 335 moths, 261 Hemiptera, 115 Coleoptera, 33 examples of mimicry and common warning colours in Lepidoptera, and 2 in Hemiptera. A magnificent series of eight males and ten females of the splendid butterfly *Ornithoptera poseidon euphorion*, in part bred and in part captured at Cooktown, N. Queensland coast (1900), were presented by H. C. Robinson, Esq.

Seven insects and arachnids from Lango, Lofoden Islands (August, September, 1903), were presented by the captor, E. N. Bennett, Esq., M.A., Hertford College. Three interesting dipterous parasites of the Norwegian Grouse are included.

Two specimens of *Precis actia*, the wet-phase parent with its dry-phase offspring (Salisbury, Mashonaland, 1903), were presented by Guy A. K. Marshall, Esq., being the third example of the genus in which the two utterly different forms have been proved to be but a single species by this distin-

guished naturalist. The specimens were exhibited at a meeting of the Entomological Society of London, and the details of Mr. Marshall's investigation are published in the Proceedings (1903, p. xxxii). Four specimens of three species of the same genus captured by Mr. Marshall, four pupae of *Precis sesamus*, and a specimen of *P. archesia*, wet-phase, kept for the whole pupal period in a dry atmosphere, were also presented. The latter is one out of a long series of experiments Mr. Marshall has made and is making in the attempt to ascertain the physiological causes of this remarkable change.

The following valuable material has also been presented by Mr. Marshall:—

Three butterflies showing injuries probably caused by the attacks of birds. One of these is the rare and beautiful Lycaenid mimic *Mimacraea marshalli*. Its model *Limnas chrysippus*, captured on the same day, was also presented. Another is a specimen of *Papilio demodocus*, in which both hind wings have been shorn by the beak of a bird almost as cleanly as if with a pair of scissors.

A set of 6 Asilid flies and their prey, the latter of the most varied description, including a male Asilid (being devoured by the female of the same species), a moth, beetles, and Aculeate Hymenoptera.

Seventy-seven Hymenoptera, including some very fine Aculeata, 20 Coleoptera, 10 Hemiptera, 4 Homoptera, 1 Neuropteron, and 10 Orthoptera.

All the above-named insects are from Salisbury, Mashonaland, 5,000 ft. (1902–3). Mr. Marshall also presented 5 Cetoniid beetles, *Pseudoclinteria infuscata*, captured by him at Beira (Nov. 1902).

Just at the close of the year a most interesting consignment arrived from Mr. Marshall, affording the best possible evidence of the food of insect-eating animals. In twenty cases Mr. Marshall carefully investigated the fragments of insects found in the stomachs of birds or contained in the faeces of lizards and mammals. The species were, as far as possible, determined, although in many cases the frag-

ments were so minute that this could not be done. In each of the twenty cases the insect remains are mounted on a card with scrupulous care. The immense amount of labour involved may be inferred from the following description of the fragments obtained from the faeces of a Mongoose (probably *Herpestes badius-gracilis*) at Salisbury, in April 1903:—

315 heads of worker termites.

83 heads of soldier termites (of at least 2 species).

Heads and other parts of 37 ants (of 4 or 5 species).

Fragments of 9 beetles (7 *Opatrum arenarium* and 2 *Usagaria australis*).

Fragments of 1 Pentatomid bug.

It is obvious that Mr. Marshall has here obtained, and made available for the study of naturalists, the most satisfactory and convincing evidence of certain aspects of the struggle for existence which is endured by insects. Some of the results are most surprising and interesting. Many persons are inclined to regard the stinging Hymenoptera as immune from attack, but a large proportion of the birds had devoured Aculeates of various kinds. Upon the whole these insects were much less fragmentary than the others, while some of them were entire. It may be inferred that the sting or the ejection of formic acid causes least inconvenience to a bird when the insect is swallowed whole—a conclusion also supported by Mr. Marshall's observation in 1899 upon a Kestrel, which invariably refused certain beetles which discharge an acid secretion when presented tail first, but always ate them when presented head first (Trans. Ent. Soc. Lond., 1902, pp. 342–3).

The whole of these interesting accessions will be described in detail at no distant date, together with many other of Mr. Marshall's gifts presented in 1902.

Seventy-three insects of various Orders, chiefly butterflies from interesting localities in Northern British Guiana (1902–1903), were collected and presented by Dr. Richard Evans,

D.Sc., M.A., Jesus College. Several species of butterflies belong to the wonderful black-hind-winged group, which is characteristic of this part of South America, and have been added to the bionomic series.

Five small but valuable Coleopterous groups exhibiting mimicry, or more probably common warning colours, from the French Congo (1892), Loanda (1893), Sierra Leone (1898), Sumatra and S.E. Brazil, respectively, were presented by the Zoological Museum at Tring, together with a similar association between Lycid beetles and their mimics from N.W. Ecuador (1897): in all 18 specimens. The same museum also presented three specimens of *Acraea excelsior* from the Kikuyu Escarpment, B. E. Africa (1900–1901), and a very valuable series of butterflies from Abyssinia. The latter await the publication of additional geographical data, and are therefore at present uncatalogued.

A specimen of the transparent-winged Sphingid moth, *Hemaris hylas*, bred Jan. 2, 1897, at Brisbane, was presented by O. E. Janson, Esq., F.E.S. The specimen is of great interest inasmuch as it still retains the scales with which the transparent parts of the wings are covered when the insect emerges from the pupa. The species is probably more completely transparent than any other Sphinx. In 1890 the Professor examined the transparent portions of the wing-membrane of this species with the microscope, and found the minute rudimentary sockets which indicated the former presence of scales. He then inferred that in this, the most extreme product of specialization in the direction of transparency, the scales, having being got rid of for a longer period than in other species, would probably be found to have sunk to a lower level of degeneration. Owing to Mr. Janson's gift it is now for the first time possible to test this prediction.

A hundred and six Lepidoptera from various localities were presented by W. J. Kaye, Esq., F.E.S. They include 27 Pierine butterflies and 2 moths from Malindi, B. E. Africa (about 1890); 37 Lepidoptera from British Guiana, among them several valuable and greatly needed accessions to the

bionomic series, and *Callitaera philis*, new to the Hope Collection; 3 butterflies from Peru, all much wanted; a specimen of *Limnas chrysippus* from St. Helena, and one from Central India; 2 specimens of the Satyrine butterfly, *Melanargia halimede*, from Tibet; and 33 Lepidoptera from various European localities, including 1 specimen of *Synchloe daplidice* and 2 of the superficially similar *Anthocaris belia*, captured together by the donor on the same day at Cannes (Mar. 17, 1899). Such resemblances, suggesting the mimetic associations so abundant in the tropics, are of much interest. It is, however, probable that the resemblance is at least in part syncryptic.

Eighty-seven butterflies from various localities in Switzerland, the Austrian Tyrol, and Carinthia were presented by R. W. Lloyd, Esq., F.E.S. The exact localities and dates add much value to the specimens. The fine series of Erebias are especially welcome. Mr. Lloyd also presented 4 butterflies from Norway (1898) and 2 rare *Elateridae* (Coleoptera) from the New Forest.

The dissection of a gynandromorphous specimen of the bee *Osmia fulviventris*, captured by Monsieur J. Vachel of Argentat, Corrèze, France, was presented by the Rev. F. D. Morice, M.A., Queen's College. The specimen, which is described in the Proceedings of the Entomological Society of London for 1903 (p. vi), is a valuable addition to the teratological part of the collection.

A hundred and forty-six butterflies from numerous localities in South Africa (Zululand, Natal, and Cape Colony) were presented by the captor, the Rev. W. H. Heale, M.A., Balliol College. A few of the species were previously unrepresented in the collection, while the localities and precise dates rendered the whole of much value.

A hundred insects of various groups were presented by Dr. T. A. Chapman, F.E.S. The series included the following local forms of Lepidoptera described by the donor, from Bejar, &c., W. Central Spain (1902):— 4 *Erebia stygne*, var. *bejarensis*; 8 *Lycaena argus*, var. *bejarensis*; 6 *Heterogyna paradoxa*, var. *bejarensis*; 6 *H. paradoxa*, var. *candelariae*

(from the Sierra de Bejar, above Candelario); 9 *H. paradoxa*, var. *piedrahitae* (above Piedrahita); also 6 cocoons of the first-named variety of *H. paradoxa*, and 9 of the last-named, and 4 *Ichneumonidae* bred from cocoons of the var. *piedrahitae*. In addition to these and other valuable accessions to the general collection from the same localities, several Spanish *Asilidae* captured with their insect prey are included. From Bejar, two of these predaceous flies, each devouring a hive-bee, and one with a beetle; from Piedrahita, an Asilid with the large butterfly *Pyrameis cardui*, an astonishing example of discrepancy in size between captor and prey; from Moncayo, two Asilids with beetles and one with a moth.

From other countries Dr. Chapman's donation includes a series of 8 moths (bred) and 2 cases of *Crinopteryx familiella* (Cannes, 1901); and 6 moths (bred) and 4 cases of *Apterona crenulella* (Locarno, 1902).

A very valuable little collection of insects from Lake Tana, Abyssinia, at a height of about 6,500 ft. (Feb. 1903), was presented by the captor, Dr. A. J. Hayes of Cairo. The attention of the donor was directed to the needs of the Department by W. L. S. Loat, Esq., who has himself given us so much valuable material. The locality renders all the specimens of such high interest that a complete list is printed below. Dr. Dixey has kindly determined and made remarks upon the *Pierinae*.

LEPIDOPTERA.

NYMPHALIDAE.

DANAINAE: 1 *Limnas chrysippus* (Linn.) ♀. The ground colour of the pale tint characteristic of Oriental specimens and usually replaced by a much darker shade in African

2 *L. chrysippus* (Linn.), var. *alcippus* (Cram.) ♂ ♂. Typical.

NYMPHALINAE: 1 *Neptis agatha* (Cram.).

1 *Precis cebrene* (Trim.).

PAPILIONIDAE.

PIERINAE: 1 *Catopsilia florella* (Fabr.) ♂.

2 *Colias electra* (Linn.) ♂ ♀.

3 *Terias brigitta* (Cram.) ♂ ♂ ♀.

Dry season forms; not extreme.

3 *Eronia leda* (Boisd.) ♂ ♀ ♀.

One of these females has an orange apical patch on the forewing, almost as distinct as that of the male.

1 *Pinacopteryx* sp.?

A female, rather worn; simulating *Mylothris agathina* ♀.

Probably a new species, but being in poor condition and a single specimen it would not be advisable to describe it.

1 *Belenois severina* (Cram.) ♀. Dry season form.

1 *Phrissura* sp. ♂.

A male, of the *P. sylvia* group. This form of *Phrissura* has not previously been recorded from any part of East Africa.

PAPILIONINAE: 8 *Papilio demodocus* (sp.) (5 incorporated).

HYMENOPTERA.

1 *Dorylus fimbriatus* (Shuck.) ♂.

COLEOPTERA.

LAMELLICORNIA.

SCARABAEIDAE: 1 *Oniticellus inaequalis* (Reiche).

Only known from Abyssinia.

CETONIIDAE: 1 *Pachnoda abyssinica* (Blanch).

1 *Pachnoda stehelini* (Schaum).

Both Abyssinian species.

PHYTOPHAGA.

CASSIDIDAE: 1 *Aspidomorpha punctata* (Fab.).

HETEROMERA.

CANTHARIDAE: 2 *Mylabris*, probably n. sp.

NEUROPTERA.

1 *Nemoptera*, probably n. sp.

ORTHOPTERA.

ACRIDIIDAE: 1 *Cyrtacanthacris* sp.
1 *Phymateus brunneri* ? (Bolivar).
1 *Phymateus leprosus* (Fab.).
1 *Petasia anchoreta* (Bolivar).
MANTIDAE: 1 *Sphodromantis bioculata* (Burm.).
1 *Chiropus aestuans* ? (Sauss.).

In addition to the above Dr. Hayes presented three insects from Gadarif, in the Soudan, including a pair of a magnificent new species of Buprestid beetle of the genus *Sternocera*, captured *in coitu*. This species will shortly be described from a specimen in the British Museum by Mr. C. O. Waterhouse. The third insect is an example of a Cantharid beetle, which does great damage to the crops at Gadarif. Its determination as *Mylabris hybrida* (Bohem.) is therefore a matter of some importance.

Sixty-seven Coleoptera of the families *Endomychidae*, *Erotylidae* and *Cleridae* from Sarawak, Borneo (captured at various dates), were presented by R. Shelford, Esq., M.A., Curator of the Sarawak Museum. The majority of the specimens were from the neighbourhood of Kuching. The Rev. H. S. Gorham very kindly examined the collection and determined nearly the whole of the species.

Thirty Bornean Hymenoptera carefully compared with specimens named and in chief part described by Peter Cameron, Esq., were also presented by R. Shelford, Esq. The specimens were collected at various dates in the neighbourhood of Kuching. A specimen of another named species of the same Order from Pankalan Ampat, at the base of Mount Penrissen (May, 1899), was presented by R. Shelford, Esq., and E. A. W. Cox, Esq.

Four specimens of two species of *Erotylidae* from the Congo and from New South Wales were presented by the Rev. H. S. Gorham, F.Z.S., F.E.S.

Monsieur Fairmaire, of Paris, presented a specimen of the Cetoniid beetle *Heterosama sycophanta*, Fairm.

Two hundred and forty insects of various Orders, the majority being Coleoptera, from Pirmaid, Travancore State (1900–2), collected by Mrs. R. Imray, were presented by the captor and the Rev. A. Thornley, M.A., F.E.S. Many of the Coleoptera are extremely fine, and include a splendid example of a large new Longicorn, which will be described by Mr. Gahan at no distant date. The whole collection is an especially valuable and welcome addition to the Department.

Eighty-two insects, chiefly Coleoptera, were presented by W. F. Rosenberg, Esq. They include an interesting Dipterous mimic (*Hyperechia*) with its model, a Xylocopid bee, collected by the late William Doherty on the Kikuyu Escarpment, British East Africa (1900–1). The remaining specimens were collected by Mr. Rosenberg himself (1896–7) in localities of exceptional interest in Ecuador, viz. Cayambe (10–12,000 ft.), the River Cachabe, Chimbo, and Paramba. They include a co-type of the fine Phytophagous beetle *Alurnus humeralis*, Rosenberg, and three groups of small Coleoptera presenting respectively the same general appearance. These compare in an interesting manner with Mr. Shelford's group from Borneo, the colouring of two of them being the same, but the affinities of the constituent species very different. A few other Coleoptera and eight interesting *Phryganidae* are also included.

Seven butterflies, six moths, and one dragon-fly, captured in Barbados by the Rev. A. J. Gill (1903), were presented by Norman H. Joy, Esq., F.E.S. Herr Jacoby kindly drew the attention of the donor to the needs of the Department.

Ten *Lycidae* (Coleoptera) from various African localities were presented by Monsieur Jules Bourgeois, of Ste-Marie-aux-Mines, Alsace. The donation is of especial value in that it consists of named specimens from the collection of this distinguished authority upon the Malacodermata.

Eleven named ants from various localities in Australia, New Caledonia, S. Africa, and S. America were presented

by Monsieur Auguste Forel, of Morges, Switzerland. These specimens, coming from the collection of the great authority upon the group, have the same interest and value as the last donation.

Ninety-five Lepidoptera, chiefly butterflies, and one beetle, from Bolivia, were presented by Mr. A. H. Hamm, of the Hope Department. The collection is by no means rich in forms from this deeply interesting part of the Neotropical Region, and the gift is correspondingly welcome.

Ninety-six Lepidoptera and one Mantis, from various localities in the Kenya District of British East Africa (1903, mostly 4,000 ft.), were presented by the captors, S. L. Hinde, Esq., and Mrs. Hinde. Included in a fine series of *Limnas chrysippus*, var. *dorippus* (= *klugii*), is one specimen more beautifully transitional towards the type-form, *chrysippus*, than any in the unique series in the Department. The data are full and precise, and the locality of great interest, rendering the collection an accession of high value.

A hundred and nineteen Lepidoptera, and four Hymenoptera Aculeata from various localities in Southern Nigeria (1902–3), were presented by the captor, C. J. M. Gordon, Esq., B.A., Balliol College. These have the same interest as the last-mentioned donation. It is quite likely that one or more of the *Lycaenidae* or *Hesperidae* of these two accessions may turn out to be new. They will be investigated at an early date.

In addition to the above, many gifts remain uncatalogued and unlabelled. A complete account of these will appear in the next Report. In the meantime the Professor desires to thank the following donors for their kind help to the University Collections:—the Rev. G. Dexter Allen, M.A. (Non-Coll.) for Swiss insects; Cecil W. Barker, Esq., and F. Muir, Esq., for insects from Durban, Natal; Horace Byatt, Esq., B.A., Lincoln College, for insects from the Central African Protectorate; George F. Leigh, Esq., for cocoons and larval cases from Durban, Natal; Sir George Denton, for a fine set of West African Rhopalocera; N. Annandale, Esq., B.A., Balliol

College, for insects from the Faroe Islands; W. J. Lucas, Esq., B.A., for insects from various localities; Champion B. Russell, Esq., M.A., University College, for butterflies exhibiting injuries probably caused by the attacks of enemies; J. A. Finzi, Esq., for a valuable series of Swiss Lepidoptera with precise data; Dr. G. B. Longstaff, D.M., New College, for Indian Lepidoptera with precise and valuable data (nearly all the specimens arrived in the present year); Miss Dorothy M. A. Bate, for a very valuable set of insects from Cyprus; and C. B. Taylor, Esq., F.E.S., for a very fine and interesting series of insects of many Orders from Jamaica. The Professor also presented a few insects from Fontainebleau.

Special mention must be made of Monsieur Charles Oberthür's generous gift of rare examples of mimetic Lepidoptera from South-western China and adjacent countries. These deeply interesting accessions arrived in part at the end of 1903, in part at the beginning of the present year. The phenomena of mimicry in the great northern land-belt as affected by the invasion of forms from the tropics presents a most fascinating problem for investigation, and Monsieur Oberthür's great kindness has furnished the Department with the material for attacking it. A full account of this invaluable gift will be furnished in the next Report, when the specimens will have been catalogued.

Just at the end of the year a deeply interesting accession arrived from Natal, presented by George F. Leigh, Esq., F.E.S. The gift consisted of a series of specimens of *Papilio dardanus* (=*cenea*) bred from the eggs of a single female. Both parents were included in the consignment. The various different forms of female are the most wonderful examples of mimicry as yet known, and this is the first occasion upon which their specific identity has been proved by breeding.

PURCHASES.

The following specimens were purchased during the year. A set of 87 South American Lepidoptera was obtained from Messrs. Watkins and Doncaster in augmentation of the bio-

nomic part of the collection dealing with mimicry and common warning colours. Many of the groups are very beautiful, and the whole provides a greatly-needed increase of the material for research. A fine set of 15 varieties of *Kallima paralekta* from Java were also purchased from Messrs. Watkins and Doncaster. The underside of this butterfly in the position of rest presents the most wonderful resemblance to a dead leaf. Although this species furnishes the classical example of protective resemblance described by Dr. A. R. Wallace, D.C.L., in his "Malay Archipelago," it has not been hitherto represented in the Hope Collection.

A very interesting series of 323 butterflies, captured on a single day in the Potaro District of British Guiana, was purchased from Mr. C. B. Roberts. They are as yet uncatalogued.

Additions to the British Collections in 1903.

A specimen of the rare British Anthribid beetle, *Tropideres niveirostris* (Kent, 1902), was presented by the captor, A. J. Chitty, Esq., M.A., Balliol College.

A most valuable series of 990 Diptera from a great variety of British localities was presented by Lieut.-Col. J. W. Yerbury, R.A. The data are most exact and all the species have been carefully worked out by Col. Yerbury. His identifications, together with the data of time and place, are now printed and affixed to all the specimens.

The bionomic series has also been greatly enriched by Col. Yerbury. Four Asilid flies and their prey, together with the Aculeate, *Oxybelus uniglumis* and its prey (Hertfordshire, 1902, and Wales, 1902–3), have received printed labels and have been catalogued; while a number of other valuable captures of the same kind will be incorporated at an early date.

Two hundred and eighty-five Diptera, beautifully set and in the most perfect condition, were presented by F. C. Adams, Esq. With the exception of one from Aberdeen and six from Colchester the whole were captured by Mr. Adams in the Lyndhurst district of the New Forest (1902).

A very interesting example of a symmetrically injured

butterfly (*Vanessa polychloros*) was presented by the captor, F. W. J. Jackson, Esq., B.A., Merton College. The specimen was captured in the New Forest in April (1893), and was therefore a hybernated individual. The costal margins of both forewings had been torn away—a very unusual form of injury.

An example of the moth *Zeuzera aesculi*, from Southmoor Road, Oxford (1903), was presented by the captor, Mr. C. R. Browning; and another specimen of the same species, from the passage east of the Divinity School, was presented by the captor, Mr. G. Tickner. This last individual was being attacked by a sparrow (July, 1903) when rescued for the Department by Mr. Tickner.

Six bred specimens of *Plusia moneta*, together with the cocoons from which they were bred, were presented by the Rev. J. W. B. Bell, M.A., Wadham College. The hybernated larvae had been found by Mr. Bell on Delphinium in the Vicarage garden at Pyrton, in the spring of 1903. A fine series of this beautiful moth, which has only recently made its appearance in this country, is a very welcome addition to the British Collections.

A hundred and twenty-nine Diptera were presented by the captor, Mr. W. Holland, of the Hope Department. The whole of these came from localities near Oxford (1901), and the collection will be a welcome addition to the fauna of our district. The first recorded example of the beetle *Gynandrophthalma affinis*, from the British Islands (Ent. M. Mag., 1902, p. 281), was presented by the captor, Mr. W. Holland. The specimen was taken in Wychwood Forest, June 18, 1899. During the past year Mr. Holland has taken the same species in numbers (Ent. M. Mag., 1903, p. 202), and has presented a series of six specimens (captured June 21) to the Department. Sixty-five insects of various orders from the neighbourhood of Oxford, and forty from the south coast of the Isle of Wight, were also presented by Mr. Holland.

A hundred and thirty-eight Diptera were presented by the captor, Mr. A. H. Hamm, of the Hope Department. Upwards

of 100 have the special interest that they were taken in the Oxford district. The remainder were from several localities in Berkshire and from S. Devon (various dates). Twenty-three insects of various Orders from the neighbourhood of Oxford (1903) were also presented by Mr. Hamm, together with an Asilid fly and its prey, a small moth, from Shotover Hill (1900), and a *Pompilus* with its Hemipterous mimic captured on the same day at Bovey Tracey (Aug. 10, 1899).

Six insects from the University Museum or its grounds (1903) were presented by the captor, Mr. H. Trim, of the University Museum. Interesting examples of bird-parasites are included in the donation.

Many kind donations to the British Collection have not yet been labelled and catalogued. Formal acknowledgement will be made in the next Report to Dr. W. Hatchett Jackson, D.Sc., M.A., Keble College; Dr. G. B. Longstaff, D.M., New College; S. A. Neave, Esq., B.A., Magdalen College; Major R. B. Robertson; Edward Saunders, Esq., F.R.S.; F. A. Bellamy, Esq.; A. J. Chitty, Esq., M.A., Balliol College; G. C. Druce, Esq., Hon. M.A., Magdalen College; W. J. Lucas, Esq., B.A.; Colonel J. W. Yerbury (for a few specimens still uncatalogued); W. C. Boyd, Esq.; F. Jenkinson, Esq., Hon. D.Litt., Trinity College, Cambridge; Miss Irene M. Cox, Miss K. Parker, Mr. Brown, and the Professor.

The addition (Dec. 21, 1903) to the collection of British Lepidoptera Heterocera, which we owe to the kindness of Dr. F. A. Dixey, Wadham College, although uncatalogued is acknowledged in detail because of the exceptional interest of two of the specimens, and because the careful record of numerous interesting and important data always renders Dr. Dixey's specimens of unusual value. The donation consists of 33 species and 105 individuals of British moths of the sub-families *Arctiadae*, *Caradrinidae*, and *Plusiadae*. The specimens were collected from 1876 to 1903 in Middlesex, Bucks, Oxon, Berks, and Devon.

The series includes two examples of the rare *Polia xanthomista* (*nigrocincta*) from North Devon, one of which is believed

to be the tenth specimen ever taken in England (recorded in Barrett's "British Lepidoptera," Vol. IV, 1897, p. 302).

Another gift which demands special mention is the fine series of British beetles, with admirable data, presented by Horace St. J. Donisthorpe, Esq., F.E.S. It is hoped that the printed labels will be supplied at no distant date.

Additions to the Hope Library in 1903.

A considerable amount of binding has been done in the course of the year, but only an inappreciable fraction of the quantity which is required and indeed urgently necessary for the preservation of valuable property.

The donations have been unusually numerous and valuable. The Professor, in classifying his private papers, came across a large number of memoirs upon the subjects of the Department which had been presented to him. These he transferred to the Library, and in the following statement they appear, for the most part, as though given by their authors.

The Boston Society of Natural History and the Bombay Natural History Society presented their publications for the year 1903.

The American Entomological Society (Philadelphia, U.S.A.) presented the publications of the years 1893, 1894, and 1902.

The publications of the Linnean Society for the year 1903, together with the Charter and By-laws (1890), and the Transactions of the Entomological Society of London for 1903 were presented by the Professor.

The volumes of "Novitates Zoologicae" of the Tring Zoological Museum were presented by the Hon. Walter Rothschild. These include Vol. IX and its supplement, the great monograph on the Hawk-moths, now bound in two additional volumes.

The University of the State of New York presented publications for 1900 (54. 1, 54. 2, 54. 3, and 54. 4), for 1901 (55), and the "Index to Publications," 1903.

The Report of the Sarawak Museum for 1901–2 was pre-

sented by the Curator, R. Shelford, Esq., M.A., Christ's College, Cambridge.

The Radcliffe Library presented the Catalogue of Books for the year.

The Manchester Museum (Owens College) presented the Report for the year.

The Council of the City of London Entomological and Natural History Society presented a set of Transactions from 1892–1902.

The Smithsonian Institution (United States National Museum, Washington) presented the "List of North American Lepidoptera," by Dr. Harrison G. Dyar, Ph.D., assisted by Dr. C. H. Fernald, Ph.D., the late Rev. George D. Hulst, and August Busck, Esq. The Smithsonian Institution also presented valuable memoirs by the following writers:—the Rev. T. R. R. Stebbing, F.R.S.,; A. N. Caudell, Esq. (two memoirs); R. W. Sharpe, Esq.; J. E. Benedict, Esq.; August Busck, Esq.; W. P. Hay, Esq.; and J. G. Needham, Esq.

The following valuable works have been presented by the Trustees of the British Museum:—a "Monograph of the *Culicidae* and Mosquitoes," by F. V. Theobald, Esq., 3 vols.; a "Monograph of the Tsetse-flies" (genus *Glossina*, Westwood), by E. E. Austen, Esq.

The Secretary of State for India in Council presented Vol. II of the Hymenoptera (Ants and Cuckoo-wasps) in "The Fauna of British India" Series, by Lieut.-Col. C. T. Bingham.

Monsieur Charles Oberthür, of Rennes, generously completed the gift of his great "Études d'Entomologie," of which he had presented the first few parts to Professor Westwood many years ago. The series is now bound and in constant use.

A splendid collection of 64 memoirs (1880–1903) was presented by the author, Professor Chr. Aurivillius, of Stockholm. A large number deal with the Ethiopian Rhopalocera, upon which Professor Aurivillius is so distinguished an authority; but other insect Orders, especially the Hymenoptera and the Coleoptera, together with the Crustacea, are also the subjects

of many valuable monographs. A few papers were written by Professor Aurivillius in conjunction with other naturalists, viz. Dr. Aug. E. Holmgren and Dr. Mayr.

A splendid collection of 162 memoirs was presented by the author, R. I. Pocock, Esq., F.Z.S. The vast majority of these deal with the groups in which Mr. Pocock is so great an authority—the Arachnida and Myriopoda ; but several are concerned with Crustacea, Limulus, the stridulating organs in the Egyptian Beetle, &c. Three memoirs upon Mammalia, not included in the above-mentioned number, have been transferred to the Radcliffe Library.

Parts V and VI of a Monograph of the Membracidae were presented by the author, G. B. Buckton, Esq., F.R.S., thus completing the work, which is now bound. In addition to this valuable donation, which contains the description of large numbers of specimens in the Hope Department, the author presented, in three volumes, the original drawings from which the plates were coloured.

Six monographs on Diptera, by Dr. J. Portschinsky (St. Petersburg, 1884–1891), were presented by the Professor.

Miss E. M. Sharpe presented a valuable series of 12 of her papers on Lepidoptera, 1899–1903, containing the description of many new species, chiefly of Rhopalocera from tropical Africa.

The valuable "Revision of the Amblypodia Group of Butterflies of the Family Lycaenidae," was presented by the author, G. T. Bethune-Baker, Esq., F.L.S.

Vol. III of "Butterflies of India, Burmah and Ceylon" (Calcutta, 1890), by the late Lionel de Nicéville, was presented by Colonel J. W. Yerbury.

Four valuable memoirs on the Onychophora were presented by the author, Dr. Richard Evans, D.Sc., M.A., Jesus College.

Part I of the Zoology of "Fasciculi Malayenses" was presented by the editors, N. Annandale, Esq., B.A., Balliol College, and H. C. Robinson, Esq.

"The Colours of Animals" (London, 1890) was presented

by the Professor, who also gave to the library a set of 21 papers on meteorological subjects by the late Mr. G. A. Rowell, of the Oxford University Museum.

The section of the library dealing with Economic Entomology has been enriched by a valuable series of the publications of the Cornell University Agricultural Experimental Station; Entomological Division (1888–1902). The series includes twenty-four papers by Mark V. Slingerland, Esq.; one by the same author, with J. Craig, Esq.; one by the same author, with J. P. Roberts, Esq., and J. L. Stone, Esq.; one by E. P. Felt, Esq.; one by William C. Thro, Esq.; also four numbers of the "Bulletin."

Of great importance to the same part of the library is the valuable series of twelve Memoirs and Reports of the Canadian Department of Agriculture, presented by Dr. William Saunders. The authors of these publications are Dr. Saunders, Frank T. Shutt, Esq., Professor J. G. Adami, and C. F. Martin, Esq.

Of equal interest to this section of the library and that which contains the works on Diptera is the following monograph:—Studies in relation to Malaria. II. The Structure and Biology of *Anopheles* (*Anopheles maculipennis*). A complete set of the five parts was presented by the authors, Dr. G. H. T. Nuttall and A. E. Shipley, Esq. This valuable work is now bound.

Original papers have also been presented by the following authors:—Carl F. Baker, Esq.; C. E. Beecher, Esq. (two memoirs); Lieut.-Col. C. T. Bingham, F.Z.S., F.E.S. (two memoirs); Malcolm Burr, Esq., F.E.S. (three memoirs); G. H. Carpenter, Esq. (two memoirs, one in conjunction with D. R. Pack-Beresford, Esq.); T. D. A. Cockerell, Esq.; H. St. J. Donisthorpe, Esq., F.E.S.; H. H. C. J. Druce, Esq., F.Z.S., F.E.S.; Francis Galton, Esq., F.R.S.; Dr. R. Gestro, of Genoa; Professor S. J. Hickson, M.A., F.R.S.; A. D. Imms, Esq.; M. Jacoby, Esq., F.E.S.; Frank Leney, Esq.; Dr. G. B. Longstaff; Guy A. K. Marshall, Esq., F.E.S. (two memoirs); Professor L. C. Miall, F.R.S., and R. Shelford, Esq.; Dr. C. S.

Minot, Hon. D.Sc.; W. T. Pearce, Esq.; Dr. A. Petrunkewitsch and Dr. G. V. Guaita; William Prest, Esq.; G. A. J. Rothney, Esq., F.E.S. (together with a memoir by Peter Cameron, Esq.); Baron C. R. Osten Sacken; Monsieur Henri de Saussure, of Geneva; O. A. Sayce, Esq. (two memoirs); E. H. J. Schuster, Esq.; Dr. W. Seh; A. E. Shipley, Esq., M.A., Christ's College, Cambridge (two memoirs, one in conjunction with Edwin Wilson, Esq.); Miss Caroline G. Soule; R. South, Esq., F.E.S.; Mark L. Sykes, Esq. (two memoirs); Abbott H. Thayer, Esq. (two memoirs); F. V. Theobald, Esq.; Roland Trimen, Esq., Hon. M.A., F.R.S.; Dr. A. Voeltzken; Dr. C. H. Vogler; the Rev. Father Wasmann (two memoirs); C. O. Waterhouse, Esq., F.E.S.; G. A. Waterhouse, Esq. (two memoirs); Professor W. M. Wheeler (two memoirs); J. J. Wilkinson, Esq.

The following publications of the year 1903 were purchased for the Department:—The parts of Barrett's "British Lepidoptera," the Ray Society volume, the volume of the Zoological Record, the numbers of the "Entomologist's Monthly Magazine," the "Entomologist," and the "Entomologist's Record."

E. B. POULTON.

Report of the Hope Professor of Zoology, 1904.

Summary of the chief accessions acknowledged in the Report for 1904.

Among the additions to the British Collections one of the most interesting has been an important Asilid fly new to the British list, captured by Mr. W. Holland at Stow Wood (June 10, 1895) and Tubney (June 2, 1901). Last year Mr. Holland's discovery of a striking beetle (*Gynandrophthalma affinis*) new to Britain, from Wychwood, was mentioned in the Report of the Hope Department. Now it is followed up by this interesting accession to the list of Diptera:—*Neoitamus cothurnatus*. The three specimens have been determined by Mr. G. H. Verrall, and were exhibited by him at the Entomological Society (Proc. Ent. Soc. Lond., 1904, p. xxxiii).

For many years the generosity of Mr. Horace Donisthorpe has been acknowledged in these Reports. During the past year he has again presented valuable additions to the British Collections, especially the beetles. Up to the present time we owe representatives of over 970 British species of this Order to his kind help.

Although properly belonging to the present year, it is impossible not to allude to the splendid collection of nearly 7,000 British Micro-Lepidoptera recently presented to the University by Mrs. E. C. Bazett, of Reading. These minute and excessively delicate specimens are most difficult to obtain in good condition, and even more difficult to "set." The existing British Collection of Micro-Lepidoptera—in part Westwood, in part Spilsbury, and in part the old Oxford Entomological Society—is by no means satisfactory; so that Mrs. Bazett's generous gift of the collection to which she has devoted many years of labour, will enable us to replace thousands of poor specimens without data by beautiful examples accompanied by excellent records. It is hoped that a full and complete account will be furnished in the Report of the present year, but an immense amount of work will be required in

"staging" the specimens, printing, labelling, and arranging. How great this is likely to be may be to some extent inferred from the number of the specimens.

Among the African accessions a deep and special interest belongs to the specimens of that remarkable mimetic "Swallow-tail"—*Papilio dardanus* form *cenea*, bred and presented by Mr. G. F. Leigh, of Durban. As long ago as 1870 Mr. Roland Trimen, F.R.S., F.E.S., brought convincing evidence that a butterfly, of which the male had been described as one species and the different forms of the female as three other species, was in reality but a single species with a non-mimetic male and three forms of mimetic females, each resembling a different model. Professor Westwood, who himself described one of these females as *Papilio trophonius*, at first doubted the interpretation, but he was ultimately convinced, and the present Professor well remembers the delight of the great naturalist when he showed and explained the fine series of forms of the female in the Hope Museum, all bred from the larvae found in the same garden in King William's Town, South Africa, by Mr. J. W. Mansel Weale. But the conclusive test of breeding from a single pair of parents had never been applied until Mr. Leigh undertook the work at Durban in 1902 and 1903. The commonest form of female of this species in Natal (*cenea*) may be called A, the rare form (*hippocoonoides*) B, the rarest form (*trophonius*) C. Mr. Leigh captured (Sept. 18, 1902) a male *in coitu* with form A. From the eggs he succeeded in rearing 18 males, 24 A-females, and 3 B-females. A year later he captured form C, and from its eggs reared 3 males and 2 A-females. Finally, during the past year Mr. Leigh watched the oviposition of form C. He failed to catch the parent, but collected the eggs and bred from them 6 males, 5 A-females, and 1 C-female. The two earlier breeding experiments are described in Trans. Ent. Soc. Lond., 1904, pp. 677–91, Plate XXXI. Further details will be found in the later part of this Report; but this final conclusive justification of Mr. Trimen's inferences of over thirty years back, is of such great importance and interest that it has been thought well

to summarize the results of the work in this section of the Report.

At the time when the above paragraphs were written it was intended to summarize the whole of the chief accessions in this part of the Report. The necessities of space have, however, prevented the fulfilment of this intention. A full account of the numerous and valuable donations received by the Department will be found towards the end of the Report.

The Rothney Collection of Hymenoptera.

In this place it is appropriate to speak of the splendid collection of Oriental Hymenoptera, containing large numbers of types, bequeathed to the Department by Mr. G. A. James Rothney, F.E.S., together with his fine British Collection of the same Order, the manuscript notebooks relating to the collections, and the parts of his library dealing with this group of insects.

In addition to the Hymenoptera, Mr. Rothney has bequeathed a very complete collection of the butterflies and dragon-flies of Barrackpore Park. The names of the butterflies have been published by Dr. Frederick Moore (*Entom. Mag.*, July, 1882).

All the books, cabinets, and boxes have been carefully labelled "Bequeathed to the Hope Department," and Mr. Rothney has made arrangements for the whole to be conveyed in a spring van by road to Oxford without any expense to the University. This generous benefactor has already sent to the Department bound volumes of the Transactions of the Entomological Society of London, being a complete set from 1872 to 1903, both years inclusive. These Transactions are more greatly needed than any other single set of volumes in the Hope Library, so that a second series will be of great value, especially when the Department spreads in a few years into the Southern Section of the old Radcliffe Library. When the Rothney Collection of Hymenoptera is added to the Collections of W. W. Saunders, Sir Sidney Saunders, F. W.

Hope, J. O. Westwood, to the numerous types of Frederick Smith, and to the large number of accessions registered in these Reports during the past ten years, the most interesting of all the Orders of Insects will be represented in Oxford by one of the great collections of the world.

Financial gifts and grants to the Department.

Much kind assistance has been rendered in the difficulty of meeting the various necessary expenses of an active and rapidly growing Department. It had been hoped that the University would be able to provide an additional £100 to the annual grant, which has only been increased by £10 since the year in which the present Professor was appointed (1893). But the state of the University finances made it impossible to expect this sum in 1904, and £50 was voted. Dr. Longstaff also made a generous contribution of £50, and a kind promise of £20 made by the late Warden of Merton a few months before his death was generously fulfilled by his executors. Dr. Longstaff, during his visits to the Department, was impressed by the congestion due to the continual inflow of material and the very insufficient means of dealing with it. He generously offered to provide another Assistant during 1905 and 1906, an offer gratefully accepted by the University on Feb. 7, 1905. Mr. J. Collins, of Warrington, has been appointed to the position, and the collections are already feeling the benefits of an increase in the power of dealing with accumulated arrears.

Visits of Naturalists.

The annual visit of members of the Council of the Entomological Society of London took place on July 2–4. There were present—the President, Professor E. B. Poulton, the Vice-President, Dr. F. A. Dixey, D.M., Wadham College, the Secretary, Mr. H. Rowland-Brown, M.A., University College, and the following members of Council :—Mr. J. E. Collin, Mr. H. H. Druce, Mr. W. J. Lucas, and Mr. A. J. Chitty, M.A., Balliol College. The following ex-Presidents of the Society

were also present:—Mr. Roland Trimen, Hon. M.A., F.R.S., Professor Meldola, F.R.S., Mr. G. H. Verrall, together with Mr. Horace Donisthorpe and Mr. M. Jacoby. The Proctors, Dr. F. A. Dixey, and the Professor represented the Hope Curators. Commander J. J. Walker and Mr. W. M. Geldart, M.A., Trinity College, kindly helped to render the visit a success. As on previous occasions, much work was compressed into a brief space of time, and the University collections have benefited in many ways.

The Department has been visited in the course of the year by many naturalists who have helped in its increase and development. They have thus been enabled to some extent to see the use which has been made of the specimens they have presented and the value that is attached to them. In some cases, however, they have come to do some definite piece of work, and had but little time to spend in seeing the collection. Thus, Mr. G. A. K. Marshall made two or three visits, but worked hard at the African Coleoptera in the Burchell Collection, and had little opportunity of inspecting the immense numbers of specimens presented by him, the brief description of which fills no inconsiderable part of these yearly Reports. It was a great pleasure to show Mr. C. A. Wiggins on more than one occasion the wonderful series of butterflies collected by him at various points around Lake Victoria Nyanza, and to show Mr. Horace A. Byatt, B.A., Lincoln College, the valued specimens sent by him from British Central Africa. Colonel J. W. Yerbury, so far as time permitted on a brief visit, looked through the British Collection of Diptera, of which he has given by far the larger part. Mr. H. S. Gladstone, who collected the Bahama specimens so much valued in the Hope Museum, visited the Department, unfortunately at a time when the Professor was away from Oxford. Miss Dorothea M. A. Bate gave valuable information concerning the specimens from Cyprus presented in 1903. Mr. W. J. Lucas similarly rendered kind assistance in the elucidation or amplification of data accompanying the specimens given by him, and in naming British specimens in the groups of which he

has made a special study. Mr. Roland Trimen, F.R.S., Professor Meldola, F.R.S., and Mr. Hamilton H. Druce in the course of their brief visits had but little time to see the valuable material they have presented to the Hope Museum.

The Department has also been visited by the following naturalists:—Professor A. Giard, of Paris, Professor Monticelli, of Naples, Miss E. M. Sharpe, Mr. N. Annandale, Deputy Superintendent of the Indian Museum, Calcutta, Mr. Willoughby Gardner, Mr. J. R. Hardy of the Manchester Museum, Mr. G. C. Champion, Mr. Selwyn Image.

Dr. Comté, Naturalist of the "Laboratoire des Soies," Lyon, came to Oxford in order to study and draw some of the Westwood types of the silk-producing moths.

Work done by the Staff.

The arrangement of the general collection of butterflies has been continued by Mr. W. Holland, who has finished another family, the *Erycinidae*. He has also arranged the *Membracidae* and allied groups of the Homoptera. In this latter work the greatest assistance was afforded by the preliminary classification of the material and the names given by Canon W. W. Fowler, D.Sc., Jesus College, as well as by the work of Mr. G. B. Buckton, F.R.S., upon a large proportion of the Hope *Membracidae*. Type labels have lately been added to all the specimens described in his "Monograph of the Membracidae." Much of Mr. Holland's time has also been occupied in incorporating the accessions, and in examining the Coleoptera for types and carefully labelling them when found. A large amount of labour was also expended in separating the Burchell specimens from the general collection and in searching for them in other directions.

Both Mr. Holland and Mr. Hamm have also continually assisted in the various pieces of special work and researches of every kind which have been carried on in the course of the year.

The largest single piece of work undertaken by Mr. A. H.

Hamm during the year has been first supplying printed labels of locality, date, and specific determination to the extensive series of British Diptera presented by Colonel J. W. Yerbury, and then arranging these with the accessions of earlier years in the order of Mr. Verrall's list of British Diptera. The collection thus arranged occupies 45 drawers in one of the old but excellent Standish cabinets. It is a great satisfaction to know that the material in this important but difficult and insufficiently studied Order is in a condition to afford assistance to the student. With this extensive piece of work and with the large amount of printing, cataloguing, and manipulation required by other accessions, Mr. Hamm has had but little time to devote to the older part of the collection, with the exception of the Burchell specimens, which have received considerable attention. He was, however, able to give part of a few weeks to the resetting of a portion of the Nymphaline butterflies in the general collection.

Southern Butterfly Faunas.

The development of the collections described below is not entirely new, for the Wollaston Canarian and Madeiran beetles, &c., have always been kept apart. It is hoped ultimately to create these collections for other special localities, principally islands, and to include other Orders as well as the Lepidoptera and Coleoptera.

The kindness of Commander Walker in presenting to the Department a fine series of insects from New Zealand and temperate South America, together with a favourable opportunity of acquiring a number of Lepidoptera from the Patagonian Andes, made it possible to form the nucleus of two special collections of butterflies, possessing remarkable interest in relation to the problems of geographical distribution. The great importance of such collections is at once realized when it is remembered that the instructive lacunae in the fauna are thus displayed at a glance. Omitting three probable stragglers, *Anosia archippus*, *Hypolimnas bolina*, and

Junonia vellida, only twelve species of butterflies are known in New Zealand. Three are *Nymphalinae*, the cosmopolitan *Pyrameis cardui* (the well-known "Painted Lady"), and two species of the same genus allied to our own "Red Admiral" (*P. atalanta*), viz. *P. itea*, common to Australia, and *P. gonerilla*, the "New Zealand Admiral," a remarkable form peculiar to the group of islands. Four are *Satyrinae*, belonging to two peculiar genera, and a third which may be peculiar but is certainly very near the northern *Erebia*. Five are *Lycaenidae* ("Blues" and "Coppers"). The affinity of the assemblage as a whole is distinctly northern. In fact there is no southern affinity, except in the *Pyrameis itea*, which being identical with the Australian species, is probably either migratory or a recent accession. Such a collection at once compels the attention to the groups which are wanting. The absence of tropical families like the *Danainae* (except for *A. archippus*) and *Acraeinae* is not to be wondered at, but there is the surprising absence of all *Pierinae* ("Whites"), *Papilioninae* ("Swallow-tails"), and, still more astonishing, *Hesperidae* ("Skippers"). Stupendous problems concerning the past history of the world are raised by a glance at this little collection, problems which are barely suggested by the separate units scattered here and there, according to their zoological affinity, throughout a vast general collection of about 60,000 specimens. They are, however, needed in the general collection for another purpose, for the study of the precise affinity of each species by comparison with its nearest allies wherever they may be found. Thus two sets of specimens are required from localities with such special interest.

Owing to Commander Walker's kind help, the special New Zealand collection contains 10 out of the 12 species, while the general collections contain a fine series of several of the species. The absentees from the former collection are *P. cardui* and one Lycaenid, both of which can probably be obtained without great difficulty.

The case of New Zealand has been treated in some detail, in order to demonstrate clearly the stimulus to thought which

it is hoped may be supplied by this extension of the University Collections.

The butterfly fauna of the Chilian and Patagonian Andes is equally interesting. There, cut off from the northern land-belt by the whole width of the tropics, is an assemblage of species almost wholly northern, and strongly northern, in affinity. This is not the case in Tasmania, the mountains of Natal or of the Cape Peninsula. It may well be that the explanation is to be found in the north and south trend of the great ranges of the New World as compared with their east and west trend in the Old. Thus a highway, or at least stepping-stones, may have been provided for the journey of northern forms across the American tropics, while the inducement to set out may have been given by the push of the advancing ice of the Glacial Period. Such hypotheses, suggested by a glance at these collections, become the stimulus for further investigation:—for example, in the study of this particular problem, the attempt to discover how far isolated northern communities still linger at great heights in favoured spots scattered through the Andes within the tropics.

Assistance in working out the material in the Department.

Commander Walker has worked in the Hope Department nearly every day since he first came to reside here in May of last year, on his retirement from active service. He has helped in the kindest manner in a great variety of pieces of work—in naming and arranging the fine collection of butterflies from Macao, presented by Mr. J. C. Kershaw, from Siam by Dr. Richard Evans, D.Sc., M.A., Jesus College; and the Burchell Collections of British Lepidoptera and Coleoptera. The latter specimens he not only determined but restored with such skill that, after nearly 100 years and at times very severe treatment, the great majority are converted into excellent specimens.

Among the other Orders in Burchell's British Collection the Diptera have been determined by Col. J. W. Yerbury, Mr.

G. H. Verrall and Mr. J. E. Collin, the Neuroptera by Mr. W. J. Lucas and Mr. Kenneth J. Morton, the Hymenoptera Aculeata by Mr. Edward Saunders, F.R.S., and the *Teuthredinidae* by the Rev. F. D. Morice.

Dr. G. B. Longstaff, D.M., New College, visited the Department many times in the year, and undertook here the chief part of his researches upon the fine collection of over 2,000 insects of various Orders—chiefly butterflies—made by him (1903 and 1904) in India, Ceylon, S.E. China, Japan, and Canada, and presented to the Department. Dr. Longstaff communicated his memoir to the Entomological Society of London in December last. The manuscript is now going through the press.

When Mr. Guy Marshall was in England in 1902 he was preparing his great monograph on the African Curculionid genus *Hipporrhinus*. On the occasion of one of his visits to Oxford he examined and named nearly the whole of this group of beetles in the University Collection. There remained, however, 15 specimens which he could only study satisfactorily by comparing them with his own collection in Salisbury, Mashonaland. He took these weevils with him for this purpose, and they have recently come back in safety. One species was found to be new, and is described in his monograph as *Hipporrhinus o'neili*. It is represented by 2 males and 1 female (the type), bearing the data "Natal, Colenso, 1880." Of the 12 remaining specimens 9 belong to known species and are now determined, while 3 of a single species are considered by Mr. Marshall to be perhaps Australian. In any case their condition renders a description inexpedient.

Colonel Yerbury's remarkable success in discovering a large fly, *Callicera yerburyi*, Verrall, new to science, during his visit to Scotland in the summer of last year, led to a critical examination by Mr. G. H. Verrall of all the available specimens of the genus to be found in collections throughout the country. Colonel Yerbury with great kindness came down to Oxford on purpose to search for examples of *Callicera* in the University Collection of Diptera. As a result, there has been brought to

light a single Mexican specimen which Mr. Verrall pronounces to be the at present unique representative of another new species.

The large amount of material in the difficult Nymphaline genus *Anaea* has been named and arranged by Mr. Herbert Druce, F.L.S.

Many Lycaenid and Hesperid butterflies from various parts of the world have been determined by Mr. Hamilton H. Druce, F.L.S., to whom is owing the satisfactory condition of the former large and difficult family.

Dr. A. Senna, of Florence, has, as in previous years, given the kindest assistance in difficulties with the *Brenthridae* ; Mr. Edward Saunders, F.R.S., with the Palaearctic Hymenoptera Aculeata and Hemiptera ; the Rev. F. D. Morice with the *Teuthredinidae* and *Chrysididae* ; Col. J. W. Yerbury with the Diptera ; Mr. M. Jacoby with the Coleoptera Phytophaga.

Much kind assistance is especially acknowledged in the succeeding section of this Report, which deals with the work expended upon Burchell's foreign collection.

Editing W. J. Burchell's notes for publication and working out the corresponding parts of his collection.

In the Report of last year the hope was expressed that Burchell's manuscript notes might be printed, so that the burden of constant reference should not be "thrown upon the original manuscript, which is a priceless possession." . . . "Then, as each paper appears, describing some part of the great collection, every naturalist could compare it with an authentic copy of the geographical notes, dates, and records of observations made by the naturalist whom Oxford honoured with the degree of D.C.L. in 1834." Not long after the time when these words were written, the opportunity for carrying out this much-needed work arose, and the copy of Burchell's manuscript was begun on May 19, 1904. If the original programme had been adhered to the work would probably have been published before the end of the same year; for it

was a comparatively simple matter to make an exact copy of the notebooks. But it very soon became clear that such a volume would lose nearly all its value if the specimens referred to in the notes were not found, determined, and when new described. Burchell's African Catalogue is a complete account of the corresponding collection, and at first it was thought sufficient to determine the South African species and print the Brazilian manuscript as it stood. The latter only provides a complete record of his captures at the very beginning of the South American journey—between July 26 and Oct. 27, 1825. Beyond this latter date the notebook contains records (brought into relation with the specimens by numbers) "of such Insects *only* as require special and particular remark"—a very small proportion of the whole collection. However, these "special and particular" remarks are of the deepest interest to the naturalist, and it was soon realized that the specimens must, as far as possible, be recovered and determined. It was therefore decided to add the name of the species, wherever possible, to the observations, accompanied by reference numbers; but to print in their present form, without addition, those Brazilian notes referring to locality only. These are indicated by dates and not numbers. To find the corresponding specimens would be an immense labour; for the vast bulk of the American collection is labelled with dates, and only a small proportion with numbers. And the gain would not be commensurate. To collect together, for example, the varied assortment of insects captured by Burchell, at Rio, on New Year's Eve, 1825, during an "Excursion to the summit of the Corcovado; from Catete and up the Valley of Laranjeiros," would be a prolonged and difficult task. Moreover, as the collection is gradually worked out and published in separate memoirs these facts will emerge, and can easily be separated and brought out in a concluding paper. Hence, while admitting the interest and importance of collecting together these assemblages of forms observed on a single day and under the same conditions, it was thought better not to defer the

present work too long in order to include them, considering that they will appear at some later date. On the other hand, such an important observation as the following *demands* the determination of the specimen referred to, when it can be found: "351 [Reference Number]. 1 [indicating a single individual]. 15th Oct., 1825. At the Discoberto do Antonio Velho [during a journey from Rio into Minas Geraes]. P. [meaning '*Papilio*,' in the wide sense]. This species and the following settle on the smooth sunny bark of the trunks of large trees, and when in their flight they meet another of the same species they appear to fight, and at the same time produce with their wings an extraordinary and loud and quickly repeated crackling noise." A specimen of the Nymphaline butterfly, *Peridromia amphinome*, L., bears the No. "351," while "352" is borne by the closely-allied *Peridromia feronia*, Hübn., the very species upon which Darwin made the same observation, a few years later, when visiting Rio, on the voyage of the *Beagle*, April 4 to July 5, 1832 ("Journal of Researches," London, 1876, pp. 33, 34).

It was therefore decided to attempt to find and determine every African specimen and every numbered specimen from other parts of the world, referred to in Burchell's note-books. This has proved to be the hardest single piece of work undertaken in the Hope Department during the past twelve years. Nevertheless, it is hoped that the whole of the manuscript will be in the hands of the printers before May 19, 1905, in less than a year from the commencement. Such comparatively rapid progress has only been possible by co-operation on a large scale, and it is a great pleasure to acknowledge the large amount of assistance which has been received in the course of this considerable undertaking. One rather extreme example will serve to indicate the kind and extent of labour which has been necessary, as well as the friendly sympathy of brother-naturalists.

Entirely out of place in one of the two boxes containing Burchell's British insects, was a very small pill-box containing —quite loose—nine minute beetles, each about the size of

a pin's head. On the lid was written in Burchell's handwriting, "Habitat in *Boleto* C. G. 3179–2." Inquiry at Kew revealed the fact that No. "3179–2" in the "Catalogus Geographicus" of Burchell's African plants was a *Boletus* collected in the "Boschberg," between Graaff-Reynet and Grahamstown, on the morning of June 5, 1813. It is likely that Burchell, examining the African herbarium in his home at Fulham, found these beetles which he had accidentally brought in the fungus. Probably they were included in the British collection because they were thus found in England; for other insects with the same history were similarly placed.

In spite of their precarious existence as specimens, exposed to injury every time the box was moved, the beetles looked wonderfully fresh after Commander Walker had skilfully cleaned and mounted them. Eight were a species of *Cis* which Mr. Guy A. K. Marshall determined as *Ennearthron cucullatum*, of Mellié. The ninth was a puzzling species which he and Commander Walker placed in the genus *Dorcatoma* (*Anobiidae*). It was taken to the British Museum, and considered by Mr. G. J. Arrow to be a *Scymnus*, belonging to a very different family, the *Coccinellidae*. It was sent to Rev. H. S. Gorham, at Southampton, and then to Dr. David Sharp, F.R.S., at Cambridge, who decided in favour of the first determination. Finally the beetle was dispatched to Monsieur Maurice Pic, of Digoin, Saône-et-Loire, who pronounced it to be a new species which he has described for the present work under the name of *Dorcatoma burchelli*.

The clerical part of the undertaking was lightened by the fact that the Professor had already in 1903 made a copy of most of the Brazilian note-book. In finishing this and the Brazilian Itinerary and in the first part of the African Catalogue, Commander J. J. Walker rendered much kind help in writing, and in reading the original for copying and for verification. Miss C. B. Sanders, of Lady Margaret Hall, also kindly assisted in the verification of the Brazilian copy. Mr. Guy A. K. Marshall, during his visit to England in the

summer of 1904, wrote out the whole of Burchell's collation of his African insects with the Banks collection and of the African beetles with Olivier's "Entomologie." He also, with the Professor, verified this and the copy of the whole African Catalogue and part of the Brazilian. With his efficient aid the whole of the immense mass of dates and the numerous localities, arranged, according to Burchell's classification of his specimens, in the African Catalogue, were again copied and redistributed to form an African Itinerary, into which were inserted the Insects, Arachnids, &c., captured upon each day. A critical comparison of this naturalist's diary with the original Catalogue was the means of detecting a few mistakes made by the most accurate and painstaking of observers. In nearly every case the nature of the error was obvious, and in all the correction is probably right. The construction of an African Itinerary was greatly aided by the kindness of the Radcliffe Librarian, Dr. W. Hatchett Jackson, D.Sc., Keble College, who permitted the removal of Burchell's "Southern Africa," in order that the map might be studied and reproduced. The copy of Burchell's work in the Hope Library is unfortunately imperfect, wanting both plates and map.

The great labour of searching through the collection for the Burchell specimens has fallen almost exclusively upon Mr. W. Holland. Large numbers of the African moths and Orthoptera have been entirely destroyed by various pests, but fortunately Burchell left the reference numbers still fixed to the pins, so that the former existence and disappearance of the specimens was attested and no further search was necessary. Such evidence barely exists in the Brazilian collection, and yet many hundreds of specimens are absent, especially during the earlier part of Burchell's residence at Rio. Therefore each missing specimen was necessarily searched for again and again until its absence appeared to be certain. Fortunately nearly all the interesting observations were made later, and the great majority of the specimens to which they refer has been found. But it is very remarkable that a much larger proportion, in fact a very high proportion, of the smaller,

older (1810–15), more battered African specimens should be accounted for, than of the comparatively fresh material in the younger (1825–30) and far larger Brazilian collection. A very valuable catalogue of the whole collection made, soon after its arrival in Oxford, under the direction of Professor Westwood, and in part by his own hands, has been and will be of the utmost assistance in determining how far the Brazilian collection was complete when it reached Oxford (Ann. Mag. Nat. Hist. 1904, p. 306). Professor Westwood took the keenest interest in the Burchell Collection and appreciated the immense value of its geographical data, of which he showed the importance in a paper read before the Ashmolean Society on Nov. 26, 1866 (see "Proceedings," also Ann. Mag. Nat. Hist., 1904, pp. 307, 308). Although he only determined a small proportion of the species, many of those which he studied were obscure and difficult, and his identifications have been of the utmost value in the present work.

Much assistance has been rendered in the search by the presence of a large printed "Burchell Coll." label affixed to the specimens in Oxford, but for this very reason the small proportion without this label was extremely hard to find. Thus several very important African specimens bore a smaller label with the same words in the handwriting of Professor Westwood. Some few had no label at all except Burchell's reference number, which being small was generally concealed by the insect itself. The difficulty was rarely increased by actual mistakes or transpositions. One of the ants referred to and figured by Burchell ("Southern Africa," London, 1822, pp. 448, 449) was labelled "China," but the mistake was easily demonstrated by the reference number, the determination of the species and the character of the pin. All Chinese specimens in Burchell's possession (none captured by himself) were transfixed by needles. Almost the only mistakes made in Oxford occur among the African butterflies and moths; and they are easily accounted for. When the collection arrived in 1865, the bodies of many of these insects had been eaten away, and the wings, often in a fragmentary condition,

were evidently lying about in more or less close proximity to the pin bearing the reference number. The wings were then brought into sets and gummed to pieces of card, on the under sides of which are to be found references to Convocation and other indications of University life. But in assigning these sets of wings to their reference numbers mistakes were occasionally made, and they could only have been avoided by the means which have now availed to set them right in, it is hoped, nearly every case—*viz.* by a critical comparison with Burchell's African Catalogue. This was written before 1825, when the specimens were in comparatively good condition; and it represents the arrangement of individuals into species by a man with the intense interest of a naturalist and the eye of an artist. The separation into what he considered to be species is clearly shown; the reference numbers of additional individuals of the same form being always "inset" to the number of the first individual. Not only have errors been corrected by this means, but species have been determined from the most hopeless fragments. For example, a part of a patternless hind wing (right side) of a small moth was found still attached to the reference number "1209." The catalogue showed this number, "inset" to "1208," borne by a moth still quite recognizable as the Pyrale, *Glyphodes unionalis*, Hübn.

Another source of difficulty and loss of time has been due to the fact that the specimens were so widely scattered:—great numbers in the duplicates disposed in various directions; the majority in the appropriate parts of the general collection, relatively few, but still a large number, in the wrong parts of it; many hundreds never incorporated at all, but kept separate in old boxes and in parts of three very old cabinets. Three of Burchell's original boxes were found untouched, two containing his British Collection and one the duplicates of his African Collection. A great many of the Lisbon specimens were found, probably untouched, in a similar box, but others had been incorporated. In many cases specimens which illustrated each other were found in entirely different places. Thus

various nests of Hymenoptera were exhibited in the small "show-cases" on the parapet of the gallery, while the bees and wasps which had constructed them were found in some one of the directions indicated above.

This sketch suggests the nature and the amount of labour —chiefly borne by Mr. Holland—which was necessary in order to disentangle one very large collection from another vast collection. A large amount of work has also been thrown upon Mr. A. H. Hamm by the state of the specimens, hundreds of which required to be mended and repinned before they could be safely moved and studied. Great age and partial, sometimes nearly complete, destruction by the worst forms of pests combined to render the task of manipulation extraordinarily delicate and difficult. The success achieved by Mr. Hamm is more complete than could have been hoped.

As the work proceeded it was often necessary to obtain evidence upon the handwriting of Professor Westwood at different periods of his life and seek information as to methods pursued, assistants employed, &c. In all such inquiries the Professor has invariably received the kindest and most efficient help from his friend, Miss Swann.

The interpretation of Spanish and Portuguese words in the Brazilian manuscript would have been a great difficulty but for the kindness of Señor Don Fernando de Arteaga.

Many of the data which have now happily been recovered could not have been obtained but for the sympathetic help of the Director of the Royal Gardens at Kew. Burchell's vast botanical collections and the manuscript notebooks referring to them are in the Kew Herbarium, and many a date and locality of importance to the collection of insects could only be decided by inquiry at Kew. Furthermore, it was most desirable to add the recognized specific names to the plants mentioned by Burchell in the records of insects, &c., captured on his two great journeys. Botanical names which are not now accepted occur frequently; but through the kindness of Sir W. Thiselton-Dyer and the staff of the Herbarium, the fullest information which could be obtained has been

provided. It is hoped that the appearance of the volume, with the full Brazilian Itinerary, stated by Burchell to be intended for the Botanical no less than for the Zoological Collections, will confer some benefits upon students in the great botanical centre of the empire.

It is in like manner a great pleasure to reflect that the appearance of this work will benefit the British Museum of Natural History, whose staff has so greatly aided in its production. Burchell gave large numbers of his African duplicates, indicated by an L. in his catalogue, to Dr. Leach for the British Museum. A large proportion of these can be found in the collection ; several have become the types of new species, several have never since been obtained. Yet the data are wholly wanting. By the publication of Burchell's catalogue, the fullest data of time and space and circumstance will be available for many of these, and something can be learnt about all of them. Furthermore, the whole study of insects will benefit from the recognition of the types of species described by Burchell himself, and by other naturalists, from the specimens in his collection. An example of the recovery of lost types suggests the kind of work which has been done, and indicates its usefulness.

Gory and Percheron brought out their great monograph on the *Cetoniadae* (" Rose-chafers " or " Rose-beetles ") at Paris in 1833. Many species described in it are spoken of as " from the cabinet of Mr. Hope." Nearly all these are well-known types in the University Collections. There remained, however, a few species—two of them types—which have never been traced, and specialists in the group have vainly searched our collections for them. All but one bear names proposed in manuscript by Burchell, but attributed by Gory and Percheron to Hope. The French coleopterists state of the single exception that their own name had been printed before they received Mr. Hope's suggestion. A sentence in Burchell's handwriting, written on a small slip of paper and gummed into his African note-book, explained the difficulty and revealed the missing types :—" Six insects borrowed by Mr. Hope, 3rd February,

1832—for publication." Then follow the numbers of the specimens, "365, 386, [3]79, 368, 369, 345." The insects with these numbers are *Cetoniadae*, bearing the names employed in the French monograph. The handwriting of the names is unlike that on any other Burchell specimen, but resembles the inscription in the copy of the monograph presented by Gory to Hope. A special peculiarity, which the two have in common, is the use of a small initial letter to capital names. Finally, Burchell's names are twice misspelt in the monograph, and the same rendering appears on the specimens.

The whole story becomes clear. Hope sent a number of his own specimens, together with six borrowed from Burchell, to help on the work of his French colleagues. Owing to some error on the part of sender or receiver, all were accepted as Hope's, and all were therefore looked for in Hope's collection. But Hope had returned the six specimens to their owner, and they only found their way to Oxford in 1865 with the rest of Burchell's insects.

We may conclude with confidence that the types of Gory's and Percheron's *Pachnoda carbonaria* and *P. leucomelana*—lost for over seventy years—are now recovered, together with other specimens described and figured in their monograph.

Allusion has been made above to mistakes in the data recorded on the specimens; but considering the great age and inevitable manipulation of the collection, it is surprising that there are so few. In the vast majority of cases it is certain that the data are correct; and, again and again, confirmation is yielded by some character of the specimen itself. As an illustration, No. "1269" in the Brazilian Notebook refers to a wasp, of which "2 or 3 nests enveloped in cotton were brought from Carmo and the insect found on opening to-day, dead, having been unable [to] expand in the cotton. . . ." Dec. 4, 1828. When the specimen bearing "1269" was recovered, it was found that a little cotton fibre was still entangled in its limbs, while the wings were not properly expanded. Again, No. "651" in the African Catalogue, placed last, unnamed, among the Longicorn beetles, bears

the record "Consocians cum *Lycis* 78–87 in floribus." Nov. 18, 1813, Uitenhage. The specimen bearing "651" is *Amphidesmus analis*, a beautiful Longicorn mimic of an entirely different group of beetles, the *Lycidae* (see Trans. Ent. Soc. Lond., 1902, pp. 515–518, and Pl. XVIII, figs. 1–10 (models) and 25 (the mimic)). Burchell had noted the association between model and mimic more than ninety years ago. This kind of verification is most inspiring. The work of the great naturalist lives again as we read his words, and recognize in the very specimens of which he wrote the truth of his observations. The investigation of the collection and the study of the notebooks reveal the fact that Burchell was the superior of every other naturalist in the preservation and labelling of material so that the record of his observations could be tested with scientific accuracy.

It is a great pleasure to acknowledge all the kind help received from colleagues in many lands. In order to show clearly the part taken by each distinguished authority, the groups of insects are arranged below in the order adopted by Burchell in his African Catalogue. It is perhaps unnecessary to state that an arrangement followed before 1825 would not be followed to-day. Families, &c., which are referred to in the Brazilian Notebook alone are inserted among the African groups.

The localities where the insects, &c., were captured are, as far as possible, considered in the order in which they were visited:—South Africa (1810–15), Portugal (April 2 to May 23, 1825), Teneriffe (June 2, 1825), the voyage to Rio (captures made on the "Wellesley," June 12 and July 6, 1825), Brazil (July 26, 1825 to March 18, 1829). The Brazilian journey did not come to an end until Feb. 10, 1830, but the notebook containing Burchell's observations after March 18, 1829, is most unfortunately missing. (See Ann. Mag. Nat. Hist., Feb. 1904, p. 98, and April 1904, p. 309.)

COLEOPTERA.

Cicindelidae and *Carabidae*. African and Brazilian,—G. J. Arrow.

CERTAIN SPECIES,—Dr. W. Horn, of Berlin, Guy A. K. Marshall, C. J. Gahan.

Dytiscidae. AFRICAN,—Guy A. K. Marshall.
BRAZILIAN,—Dr. David Sharp, F.R.S.

Buprestidae. AFRICAN,—J. J. Walker.
CERTAIN SPECIES,—C. O. Waterhouse.

Throscidae. BRAZILIAN,—G. J. Arrow.

Elateridae. AFRICAN,—Guy A. K. Marshall.
BRAZILIAN,—C. J. Gahan.

Cyphonidae. BRAZILIAN,—G. J. Arrow.

Lycidae, *Lampyridae*, and *Telephoridae.* AFRICAN AND BRAZILIAN,—Monsieur Jules Bourgeois, of Ste. Marie-aux-Mines [Markirch], including the description of four new species in Ann. Mag. Nat. Hist., 1904, Feb., pp. 89–102, and two in the present work.

Melyridae. AFRICAN,—J. J. Walker.

Cleridae. AFRICAN AND BRAZILIAN,—J. J. Walker, Guy A. K. Marshall, C. J. Gahan.
CERTAIN DIFFICULT SPECIES,—Rev. H. S. Gorham.

CLAVICORNIA. AFRICAN AND BRAZILIAN,—G. J. Arrow.
CERTAIN OBSCURE BRAZILIAN SPECIES,—Monsieur A. Grouvelle, of Issy-les-Moulineaux, Seine.

Histeridae. BRAZILIAN,—George Lewis, F.L.S.

Passalidae. BRAZILIAN,—G. J. Arrow.

LAMELLICORNIA. AFRICAN AND BRAZILIAN,—chiefly named by G. J. Arrow, who also described one new African species. The African Lamellicorns were also carefully studied by Guy A. K. Marshall, who named many species unrepresented or incorrectly determined in the National Collection. A few of the most difficult were taken by him to Cape Town, where further kind help was rendered by L. Péringuey. Assistance in special difficulties in the *Cetoniadae* was kindly rendered by O. E. Janson.

In this group the history of British Museum types has been made clear. The type of Burchell's *Aphodius vespertinus* (with co-types in the British Museum), and six specimens described by Gory and Percheron (two of them types) have been recovered.

HETEROMERA. AFRICAN AND BRAZILIAN,—chiefly named by C. J. Gahan. Much assistance was also rendered by G. J. Arrow, and, in the case of the African species, by Guy A. K. Marshall, in the American by G. C. Champion. Further help with a few of the most puzzling African species, taken to Cape Town, was given by L. Péringuey.

Burchell's type of *Moluris vialis* (with co-types in the British Museum) was recovered.

Anthribidae. AFRICAN AND BRAZILIAN,—Dr. Karl Jordan.

Brenthidae. AFRICAN,—Guy A. K. Marshall.
BRAZILIAN,—C. J. Gahan.

Curculionidae. AFRICAN,—Guy A. K. Marshall, including the description of three new species after comparison with his collection in Salisbury, Mashonaland. Assistance was also given by J. J. Walker and G. J. Arrow.
BRAZILIAN,—G. J. Arrow, C. O. Waterhouse, G. C. Champion, and J. J. Walker.

Ptinidae. BRAZILIAN,—J. J. Walker.

Anobiidae. AFRICAN (one specimen of a *Dorcatoma* and one of a *Theca*),—both new, and described by Monsieur Maurice Pic, of Digoin, Saône-et-Loire. Opinions upon these puzzling little beetles were also kindly given by J. J. Walker, G. J. Arrow, Rev. H. S. Gorham, and Dr. David Sharp.

Bostrichidae. AFRICAN,—Monsieur P. Lesne, of the Museum d'Histoire Naturelle, Paris, who described one new species. Assistance was also rendered by C. J. Gahan.

Cioidae. AFRICAN,—Guy A. K. Marshall.

Bruchidae. AFRICAN,—One puzzling species studied by Guy A. K. Marshall, J. J. Walker, W. F. H. Blandford, David

Sharp and P. Lesne. It was finally placed in or near the genus *Urodon*.

Longicornia. African,—Karl Jordan. Kind help was also rendered by Guy A. K. Marshall and C. J. Gahan. The latter described two new species.

Brazilian,—C. J. Gahan.

Cassididae. African,—Guy A. K. Marshall.

Brazilian,—C. J. Gahan, G. J. Arrow, C. O. Waterhouse.

Phytophaga (exclusive of *Cassididae* and *Hispidae*). African and Brazilian,—M. Jacoby, who not only determined the large numbers of species, but described two that were new. Help was also given by C. J. Gahan.

Hispidae. Brazilian,—C. J. Gahan, G. C. Champion.

Endomychidae and *Erotylidae*. Brazilian,—G. J. Arrow.

Coccinellidae. African and Brazilian,—G. J. Arrow. An African species not in the British Museum was studied by Guy A. K. Marshall, and finally named by Rev. H. S. Gorham, who also kindly determined a few of the more difficult American forms.

Larvae of Coleoptera. Brazilian,—Lampyrid larvae were studied by Jules Bourgeois, and two interesting and difficult forms by C. O. Waterhouse.

Coleoptera. Portuguese and Canarian,—J. J. Walker. Assistance was also rendered by Monsieur Jules Bourgeois, G. C. Champion, G. J. Arrow, C. J. Gahan, and Canon W. W. Fowler.

ORTHOPTERA.

All Localities,—W. F. Kirby, Guy A. K. Marshall (African species only).

Obscure and difficult species,—Señor Don Ignacio Bolivar, of Madrid, who also gave advice on questions of terminology, &c.

RHYNCHOTA-HEMIPTERA.

African and Brazilian,—W. L. Distant, Guy A. K. Marshall (African species only).

Certain Brazilian species,—G. C. Champion, Edward Saunders, F.R.S.

Portuguese species,—Edward Saunders, F.R.S.

RHYNCHOTA-HOMOPTERA.

All localities,—W. F. Kirby, Guy A. K. Marshall (African species only).

Certain species which offered special difficulty,—W. L. Distant.

LEPIDOPTERA.

Portuguese and Canarian,—W. Holland, A. H. Hamm.

LEPIDOPTERA-RHOPALOCERA.

The whole of the butterflies, both African and American (with the exception of the *Lycaenidae*, *Pierinae*, and *Hesperidae*), had been dealt with in the course of the determination and arrangement of the whole Collection by W. Holland, of the Hope Department. The Burchell Rhopalocera have been confirmed, with modification in certain cases of special difficulty, by the following specialists:

African,—Roland Trimen, M.A., F.R.S., who had determined the *Lycaenidae* and *Hesperidae* many years previously. For the purpose of the present work he carefully re-studied them, and consulted with Hamilton H. Druce on special difficulties arising out of the fragmentary condition of some of the specimens. F. A. Heron also gave his opinion on special cases among the *Satyrinae*.

Pierinae. African,—F. A. Dixey, who had previously determined the species, and had recognized in certain tattered

fragments Swainson's type of *Teracolus subfasciatus* and of the genus *Teracolus*. Many obscure points were reconsidered by F. A. Dixey for the purpose of this publication.

Ithomiinae, *Danainae* and *Satyrinae*. BRAZILIAN,—Cora B. Sanders, with the assistance in Oxford of W. Holland, and in London of F. D. Godman, D.C.L., F.R.S., F. A. Heron and G. C. Champion.

The most obscure and difficult *Ithomiinae* had been named several years ago by the late O. Salvin, F.R.S., and W. F. H. Blandford.

NYMPHALINE GENUS *Anaea*. BRAZILIAN,—Herbert Druce.

Lycaenidae. BRAZILIAN,—Hamilton H. Druce.

Pierinae. BRAZILIAN,—F. A. Dixey.

Hesperidae. BRAZILIAN,—F. D. Godman, D.C.L., F.R.S.

OBSCURE BRAZILIAN SPECIES IN REMAINING GROUPS,—G. C. Champion, F. A. Heron, Karl Jordan, J. J. Walker.

LEPIDOPTERA HETEROCERA.

AFRICAN,—Guy A. K. Marshall, J. J. Walker, A. H. Hamm.

CERTAIN OBSCURE AFRICAN SPECIES,—Sir George Hampson kindly helped in the determinations. W. L. Distant was consulted upon a species described by him.

Sphingidae. AFRICAN,—Dr. Karl Jordan.

MICRO-LEPIDOPTERA. AFRICAN,—J. Hartley Durrant. A new species was described by Lord Walsingham, F.R.S.

Skins of Larvae. AFRICAN,—Lieut.-Col. J. Malcolm Fawcett, Sir George Hampson, Dr. Karl Jordan, G. F. Leigh, Guy A. K. Marshall, Roland Trimen, F.R.S.

HETEROCERA ON VOYAGE TO RIO,—J. J. Walker.

HETEROCERA. BRAZILIAN,—W. Schaus. Sir George Hampson had previously described two new species.

MICRO-LEPIDOPTERA. BRAZILIAN,—J. Hartley Durrant.

NEUROPTERA.

African,—Guy A. K. Marshall and W. F. Kirby. The latter described a new genus, a species, and the female of an *Aeschna*.

Neuroptera. Brazilian,—W. F. Kirby.

Mallophaga. Brazilian,—E. E. Austen.

HYMENOPTERA.

African and Brazilian,—Col. C. T. Bingham.

Chrysididae,—Rev. F. D. Morice.

Ants,—Professor Auguste Forel, of Morges, who described one new species.

Mutillidae,—Monsieur Ernest André, of Gray, Haute-Saône.

Anthophila (many species),—Dr. H. Friese, of Jena.

Ichneumonidae (A single Portuguese species),—Claude Morley, who also determined the genera of Brazilian species.

Portuguese *Aculeata*,—Edward Saunders, F.R.S., who also gave advice upon the whole collection of Hymenoptera.

DIPTERA.

African, Portuguese, and Brazilian,—Col. J. W. Yerbury.

Certain species,—E. E. Austen, G. H. Verrall.

Borboridae on voyage to Rio,—J. E. Collin.

ARACHNIDA and MYRIOPODA.

African, Portuguese, and Brazilian,—R. I. Pocock.

Brazilian Chelifers,—Dr. C. With, of Copenhagen.

CRUSTACEA.

Portuguese and Brazilian,—Dr. W. T. Calman.

An obscure Isopod. Brazilian,—Dr. Budde-Lund, of Copenhagen.

In addition to the invaluable assistance which—as it is hoped—is clearly set forth in the above statement, the attempt to trace the African specimens which Burchell gave away or exchanged has been aided by many kind friends. Of the numerous specimens given to the British Museum, a large proportion has been found. Mr. G. J. Arrow and Mr. C. J. Gahan helped in the search for them among the Coleoptera, Mr. W. F. Kirby among the Orthoptera and Neuroptera, Mr. W. L. Distant among the Hemiptera, Col. C. T. Bingham among the Hymenoptera, Mr. E. E. Austen among the Diptera. Dr. David Sharp, F.R.S., gave the information that a few specimens given to Professor Henslow, and a larger number given to Mr. Swainson, are not to be found in the University Collections at Cambridge. Miss Sulivan similarly states that specimens given to the late Mr. Stephen Sulivan, of Fulham, are not to be found.

It is impossible sufficiently to emphasize the amount of help received from Mr. Guy A. K. Marshall in the preparation of the African section of the work. His remarkable knowledge of Southern Ethiopian forms has enabled him to confirm many doubtful determinations and correct many errors in the identifications. Mr. Marshall was also able to detect mistakes made by Burchell; but since his return to Africa he has made further inquiry and conducted further observations, finding that in some cases Burchell was after all right in his statements. The result of the whole critical examination to which Burchell's manuscript and the corresponding parts of his collections have been subjected, is to produce the profound conviction that he was the most accurate of observers. His errors were almost invariably due to a want of technical zoological knowledge in some special branch, so that he often placed his Brazilian insects in wrong groups. But such mistakes are easily set right and do not impair the priceless value of his observations on habits and his trustworthy registration of dates and localities. There is a wide difference between Burchell's African and Brazilian Notebooks as regards these technical mistakes. The much smaller African collection

was most carefully studied and worked out by him in the interval between his return home in 1815 and his departure for Brazil in 1825. The immensely larger Brazilian collection was never studied in this way, and the names are merely the off-hand impressions of a naturalist abroad, without the materials or the time for study—a naturalist moreover who was a botanist far more than a zoologist, and a zoologist rather than an entomologist. But Burchell had a keen love for insects as well as for all other animals, and when he compared his African species with the Banksian specimens named by Fabricius, he worked with the critical insight of a trained and acute observer. The investigation of his conclusions has made it clear that his interpretations are in some instances more correct than those which have since been adopted and have become the basis of existing terminology.

The number of specimens in various groups existing in the Hope Collection.

I. LEPIDOPTERA AND COLEOPTERA.

For many weeks Commander Walker has most kindly been at work upon a catalogue of the number of specimens in the Hope Collection. Members of the University have sometimes been astonished at the needs of the Department, and therefore it has been thought well to furnish a statement of the extent of the Collections at the present date. It is not possible to complete the list of all the Insect Orders in time for this Report; but the following statement is complete so far as it goes. The remainder of the list will appear in the Report of the present year.

LEPIDOPTERA.

Exotic Rhopalocera.

Danainae, including *Ithomiinae* .	5727	specimens in	170	drawers
Satyrinae	5376	„	100	„
Elymniinae . . .	205	„	10	„
Morphinae and Brassolinae	922	„	80	„
Acraeinae	1854	„	40	„

Nymphalinae, including *Heliconinae*	15487	„	460	„
Erycinidae . . .	2348	„	45	„
Lycaenidae . . .	5704	„	61	„
Pierinae	10096	„	300	„
Papilioninae . . .	4274	„	135	„
Hesperidae . . .	3448	„	17	„
Total . . .	55441	specimens in	1418	drawers
Add . . .	213	in Table Cases		
„	32	reputed British		
Grand Total . .	55686	Rhopalocera		

The collection includes the following special series:—

Limnas chrysippus	represented by	582	specimens
Danais archippus	„	121	„
Hypolimnas Misippus	„	217	„
H. Bolina	„	216	„

Exotic Heterocera.

Sphinges—

1486 specimens in 57 drawers

Heterocera other than *Sphinges*—

30642 specimens in 287 cab. drawers + 102 boxes

Grand Total, 32128 Heterocera

British Lepidoptera.

Rhopalocera . .	1613	specimens in	15	drawers
Heterocera . .	19800	„	125	„
Total . .	21413	specimens in	140	drawers
Add . .	3422	supplementary Heterocera		
Grand Total .	24835	specimens (British)		

Total of Lepidoptera:

				Drawers.
Rhopalocera	Exotic .	55686	in	1418
	British .	1613	„	15
		56799		1433
Heterocera	Exotic .	32128	„	287
	British .	23222	„	125
Grand Total .		112149	„	1845 + 102 boxes

COLEOPTERA.

Wollaston Collections.

Canarian	5675
Cape Verde Islands	146
St. Helena	112
Total	5933
Madeira	5528
Total, Wollaston Coleoptera	11461

Tylden Collections (exclusive of those incorporated in the general collection).

Curculionidae	6680
Curculionidae, supp.	1800
Curculionidae	1945
Buprestidae	682
Total Tylden Coleoptera	11107

Miers Collections (exclusive of those incorporated).

I.	*Cicindelidae*	30
II.	*Carabidae*	2505
III.	*Dytiscidae*	194
IV.	*Hydrophilidae*	206
V.	*Staphylinidae*	999
VI.	*Clavicornia*	2191
VII.	*Lamellicornia*	4010
VIII.	*Buprestidae*	627
IX.	*Elateridae*	1084
X.	*Malacodermata*	1059
XI.	*Heteromera*	2704
XII.	*Rhynchophora*	6229
	Anthribidae (now at Tring)	
XIII.	*Hispidae*	118
	Total Miers Coleoptera	21956

General Collections.

Cicindelidae	1689
Carabidae	12166
Paussidae	258
Dytiscidae (including *Gyrinidae*)	2080
Hydrophilidae	1208
Staphylinidae	2813
Clavicornia	7399
Lucanidae and *Passalidae*	1748
Cetoniadae	3912
Lamellicornes (other than *Cetoniadae*)	19124
Buprestidae	3716
Elateridae	3006
Malacodermata	3616
Heteromera	13157
Rhynchophora	11204
Longicornes	14690
Phytophaga	18637
Total General Collection of Coleoptera	120423
Wollaston	11461
Tylden	11107
Miers	21956
British	29487
Grand Total of Coleoptera	194434

Thus the Lepidoptera and Coleoptera are represented in the Hope Department by 306,583 specimens.

Work published in 1904.

Mr. S. A. Neave, B.A., Magdalen College, left this country for Northern Rhodesia in January of last year. His paper on the large collection of Rhopalocera from the shores of the Victoria Nyanza, presented by Mr. C. A. Wiggins, was described in last year's Report. It appeared in "Novitates Zoologicae," Vol. XI, March 1904, pp. 323–363.

Three papers on W. J. Burchell and his collections in the Hope Department appeared in the early part of 1904, and were described in last year's Report. One part of a fourth paper on the first three sub-families of Brazilian butterflies, by Miss Cora B. Sanders, of Lady Margaret Hall, appeared in April, the second in May (Ann. Mag. Nat. Hist., pp. 305 and 356). An introduction and notes were contributed by the Professor, while Professor Westwood's manuscript catalogue and notes were also incorporated. Commander Walker kindly aided in seeing these papers through the press, a task greatly increased by the immense number of dates and figures.

The first important memoir on the Majorcan collection, made by Mr. Holland, Mr. Hamm, and the Professor in 1901, was published in the course of the year, being an account of the Hymenoptera Aculeata by Mr. Edward Saunders, F.R.S. (Trans. Ent. Soc. Lond., 1904, pp. 591–665). The paper also included the Aculeates captured in Spain on the same expedition, and by the Professor in 1902. In the mainland collection 205 species were recognized, in that from the island 143; but the latter included 5 species new to science—*Pompilus poultoni*, *Mimesa palliditarsis*, *Halictus hollandi*, *H. hammi*, and *H. dubitabilis*. Of these, only the last-named occurs in the mainland list. The Professor contributed introductory accounts of the expeditions, notes on some of the species, and an Appendix on the mimetic resemblance borne by certain Diptera to the stinging Hymenoptera. The preparation of the paper and the correction of the proofs brought a great deal of work upon Mr. A. H. Hamm.

The chief results of Mr. G. F. Leigh's paper upon the breeding of *Papilio cenea* and *Hypolimnas misippus* have been already described (p. 18). The paper appeared in Trans. Ent. Soc. Lond., 1904, pp. 677–691. The Professor contributed notes, and Mr. Roland Trimen, F.R.S., an Appendix, on "The *merope*-group of the genus *Papilio*." The photographs from which the two very successful half-tone plates were executed were taken by Mr. Alfred Robinson.

Major Manders' paper on breeding experiments on *Catopsilia*

pyranthe, and notes on migration of butterflies in Ceylon (Trans. Ent. Soc., 1904, p. 701), also deals with the material of the Department, kindly presented by the author.

Exhibitions of specimens belonging to the Department were made at the majority of the meetings of the Entomological Society of London throughout the year, accompanied by descriptive notes, which are published in the "Proceedings." The exhibitors and authors of notes were Dr. F. A. Dixey, Commander J. J. Walker, Mr. G. H. Verrall, Dr. T. A. Chapman, Col. J. W. Yerbury, Mr. G. J. Arrow, Mr. C. O. Waterhouse, Dr. G. B. Longstaff, and the Professor.

The following short papers by workers in the Hope Department or upon its material have also appeared in the Proceedings of the same Society in the course of the year:—"On the identity of the 'Bugong' used as an article of food by the natives of Australia," by Dr. F. A. Dixey; "A possible explanation of insect swarms on mountain-tops," by the Professor; "The oviposition of *Vanessa urticae*," by Mr. A. H. Hamm; "The courtship of *Vanessa urticae*," by the Professor; "*Erebia evias*, var. *peñalarae*, and *E. stygne*, var. *peñalarae*," by Dr. T. A. Chapman; "The scent of male Pierine butterflies," by Dr. F. A. Dixey; "*Pieris rapae* seeking white flowers as a resting site," by Mr. A. H. Hamm.

Dr. G. B. Longstaff's memoir, now in the press, has already been referred to on p. 26.

In addition to the above list of papers and those published in last year's Report, there are two Presidential Addresses delivered to the Entomological Society of London by the Professor—in 1904, "What is a species?"; in 1905, "The bearing of the study of insects upon the question 'Are acquired characters hereditary?'." It will, therefore, be seen that the materials for the issue of a fifth volume of "Hope Reports" are rapidly accumulating.

Additions to the Collections in 1902.

One thousand and ninety-one butterflies, 34 moths, 2 Hemiptera, 1 Asilid fly, 4 Hymenoptera Aculeata, including

a pair of Mutillids taken *in coitu*, 7 Coleoptera, 19 Neuroptera, and 1 Orthopteron were presented by Guy A. K. Marshall, Esq. The specimens were captured in the following localities in Natal:—Estcourt, 4–5000 ft. (1896); Niginya, Ulundi, near Estcourt (5,800 ft.), and Ulundi (5,000 ft.); Tugela River, near Weenen, 2,500 ft. and 4,000 ft. (1896); Weenen (1896); Chuga's Hill, near Weenen, 4,000 ft. (1896); Loskop, Little Tugela River, 4,500 ft. (1896); Karkloof, 4,200 ft.; Frere, 3,800 ft. (1896); Port Shepstone, sea level (1897); Durban, and the following localities near it:—Berea, 500 ft. (1897); Malvern, 800 ft.; Claremont, 200 ft. (1897); Northdene, 800 ft. (1897); Isipingo, sea level (1896); Sydenham, 400 ft. (1897); the Palmiet River.

In addition to the above important accessions to the general collection the bionomic series owes to Mr. Marshall the following additions, from Natal:—A magnificent Ichneumonid mimic of a Fossorial wasp (*Salius*) from Estcourt (Nov. 1896); 4 Asilid flies with their prey—a beetle (Malvern, Nov. 1902); a bug, a Cicada, and a species of Asilid smaller than its captor (all from Estcourt, Nov. 1902); a Chalcid parasite bred from the pupa of the Pierine butterfly, *Belenois mesentina* (Natal only).

In 1896 Mr. Marshall conducted an interesting series of experiments upon Pierine and Nymphaline butterflies for the purpose of testing the power of climatic conditions (moisture and temperature) to produce the seasonal phases which are known to occur in nature. A large part of this material was presented to the University Collections many years ago, and formed the material upon which a part of Dr. F. A. Dixey's paper on "Seasonal Dimorphism in Butterflies" was written (Trans. Ent. Soc., Lond. 1902, pp. 199–216). In 1902 Mr. Marshall presented the whole of the remaining results of these experiments which he had kept for his own collection. The specimens are as follows:—

One *Teracolus annae*, ♂, the pupa of which had been kept in a damp jar for the last nine out of the thirteen days of its pupal period (near Weenen, Tugela River), 2,500 ft. (1876).

Two specimens of *Pinacopteryx pigea*, the pupae of which had been kept in damp, and one, the pupa of which had been subjected to normal conditions.

Four specimens of *Crenis boisduvalii*, of which one pupa had been subjected to dry heat, two to excessive moisture and one to normal conditions.

Mr. Marshall also presented a specimen of *Teracolus auxo*, bred from the egg laid by *T. topha*. This additional material has been described by Dr. Dixey, and will appear in the Proc. Ent. Soc. Lond. for 1905.

Four hundred and thirty-eight Rhodesian butterflies, 30 Neuroptera, 11 Orthoptera, and 3 other insects were presented by Guy A. K. Marshall, Esq. This fine collection was made in the following localities in Mashonaland, Rhodesia:—Umfuli River, Gadzima (Oct. 1895); Gadzima, 4,200 ft. (Aug., Oct., Dec. 1895); Enterprise Camp, Salisbury, 5,000 ft. (July 1895); Salisbury (1895–1902); Hartley Hills, 4,300 ft. (July 1895); Mombi River, Upper Umfuli River (1895); Hanyani River (Oct. 1901); Upper Hanyani River, 4,700 ft. (1895); Marudzi River in the Mazoe District (1894–5); Saruwe River, Mid Umfuli River, Hartley District, 4,200 ft. (1895); near Hartley, 4,200 ft. (1895); Mt. Chirinda, Melsetter (Nov. 1901).

In addition to the above the following interesting material bearing on the struggle for existence; all collected at Salisbury, Mashonaland:—A Pyralid moth, together with minute Diptera bred from hyperparasitic larvae which had fed upon the parasite of the larva of the same species of moth (1899). Diptera captured upon a specimen of *Pachylomera femoralis* (1899), and upon a large spider (1899). A Dipterous parasite of *Caprimulgus mosambicus* (1898), and of the Dusky Fly-catcher (1898).

Four Lamellicorn Coleoptera belonging to the *Glaphyrini* (from Namaqualand, Malvern, near Durban, and other uncertain localities); 1 Pierine butterfly (a *Teracolus*) captured on the Dingidingi River, a tributary of the Pungwe (Aug. 1894), by C. N. Barker, Esq.; and a Lycaenid butterfly captured by the same naturalist at Beira (July 1896) were also presented by Guy A. K. Marshall, Esq.

In addition to the above, Mr. Marshall presented 88 butterflies captured in the Khasia Hills, Assam, of which 52 have been catalogued and incorporated; together with 15 from Sikkim. All these came of the collection of the late Lionel de Nicéville, Esq., and they constitute a valuable addition to the collection from the point of view of species, but precise data are unfortunately wanting.

A fine series of butterflies, collected by Major Rattray (Nov., Dec. 1900) at a height of 7–9000 ft. in Toro, W. Uganda, was presented by C. A. Wiggins, Esq. The locality confers special value upon representatives of even the commonest species, but large numbers of species are rare and new to the Department, a few being even new to science. Of the latter, *Pentila clarensis*, was described by Mr. S. A. Neave, B.A., Magdalen College, in 1903 (Ent. Monthly Mag., 1903, p. 136), while *Pseudacraea tirikensis* and *Pinacopteryx dixeyi* were described by him in 1904 (Nov. Zool., vol. xi, incl. 1904, pp. 323–63).

No less than 459 specimens have been catalogued and permanently incorporated, while a large additional number in poor condition have been added and will remain in the collection until it is possible to replace them by better specimens. The Toro specimens include a fine set of the Danaine, *Melinda mercedonia* (all ♂), and the following species which were greatly wanted in the Department:—*Harma confusa*, *Diestogyna amaranta*, *Mesoxanthe ethosea*, *Pseudargynnis hegemone*, a fine set of Euralias, viz. *anthedon* 11, *mima* 14, *dubia* 8, *Vanessula milca* 8, *Planema latifasciata*, *P. poggei*, *Acraea toruna*, *A. oreas*, *A. sotikensis*, and a very remarkable ♀ of *Papilio cynorta* (?).

The following large and valuable gift the Hope Department owes to the generosity of its kind friend, Herbert Druce, Esq., F.L.S., F.Z.S.:—

From the Rio Caqueta on the south-east boundary of Colombia, collected by T. Alexander and M. Eder — 57 Lepidoptera.

From the Bogota district of Colombia—78 butterflies, in part collected by Birchell, in part by Carder (about 1896), and in part of unknown origin.

From Ecuador, including the localities Balsampamba, Angamarca, and Malo—71 butterflies, in part collected by Buckley, in part by Cole, and in part of uncertain origin.

From various Neotropical localities (Costa Rica, Amazon, Para, Santarem, Parana (S. Brazil), Paraguay, Argentina)—32 butterflies.

From North America, from a great variety of localities—23 butterflies, many of them bearing very precise data.

Tropical West Africa—78 Lepidoptera, the great majority butterflies; from many localities often given in great detail.

East and South Africa—60 butterflies, from a number of localities.

From Madagascar—11 Lepidoptera, the data very precise in most cases. From the collections of Humblot, Waters, and Hobson.

From Lushai, U. Burma; the Khasia Hills, Assam; the Himalayas; Baxa, N.E. India; Mhow, Central India; Bangalore, Mysore; and Ceylon—39 butterflies.

From the Andaman Islands—3 butterflies, and Nias Island—2 butterflies.

From Hong Kong; Haining, E. China; Chusan Island and Tygosan Island, the Chusan Archipelago—8 butterflies. All with admirable data, collected by Commander Walker during the voyage (1890-3) of H.M.S. "Penguin."

From Western and Central China—5 butterflies.

North Borneo. From Labuk, Kini Balu, and Selacan, collected by A. L. Cook; from Sarawak and Trusan, collected by Everett—36 butterflies.

From North Celebes, Sumbawa, Amboyna, Batchian Island, the Philippines, New Ireland, &c.—20 butterflies.

From New Guinea (Etna Bay, Kapaur), collected by Webster, Doherty, &c.—20 butterflies.

From the Kei Islands, collected by Webster and Langin—21 butterflies.

From Australia (various localities in Queensland and New South Wales)—15 butterflies.

From Japan, 15 butterflies.

Four Odonata (Dragon-flies) from the Sierra Guadarrama (July 1902) were presented by the Professor. Omitted accidentally when the rest of the collection from this locality was catalogued in 1904.

Additions to the British Collections in 1902.

During his visit to England in 1902, Mr. Guy A. K. Marshall collected at the end of August and beginning of September, near Wroxham, Norfolk, and presented the fine collection which he then made, to the Hope Department. The series, which has now been catalogued, contains 277 Hymenoptera and 198 Diptera, in addition to the following bionomic collection:—

A Stratiomyid fly, *Beris vallata*, ♀, mimicking a common Tenthredinid, the mimic and a couple of the models taken on Umbelliferous flowers within a few yards of each other (Sept. 4). This, it is believed, is the first record of mimetic resemblance to this particular form of model, although Tenthredinid larvae have been long known to be mimicked by the young larvae of *Endromis versicolor*.

A beautiful mimetic, or synaposematic group of 9 black and yellow-banded specimens captured in close proximity on Umbelliferous flowers (Sept. 1). Of the individuals 5 are Aculeate Hymenoptera, 1 an Ichneumonid, and 3 Diptera.

Three examples of the Fossorial wasp, *Oxybelus uniglumis*, together with its Dipterous prey (Sept. 5).

The fly *Scatophaga*, with a smaller fly which it had captured (Sept. 5).

An interesting series of specimens illustrating important parts of the life-history of *Crabro chrysostomus*. First, 11 *Syrphid* flies stored up in burrows in rotten wood made by the Fossor; 2 of the latter bred from cocoons found in the burrows; a large number of Chalcid parasites which emerged from three other cocoons. The specimens were collected, Sept. 5, and the insects bred out in Oxford during the following year (1903). An examination of the 11 Dipterous victims, conducted with

the kind help of Col. Yerbury, led to very interesting results. All were superficially alike and all were females; yet 2 genera and 4 species were represented in the set:—*Syrphus euchromus*, 2; *Platychirus manicatus*, 4; *P. scutatus*, 4; *P. peltatus*, 1. The superficial likeness seems to indicate that the wasp seeks its prey by sight; the fact that all are females suggests the possibility that this sex is specially selected because of the larger amount of nutriment which is thus supplied to the larvae by each individual fly.

Additions to the Collections in 1903.

Eighty-one Lepidoptera, including a few moths, from the Gambia district, were presented by Sir George Denton. They had been captured probably during July and August, 1903, by Commissioner Pryce. Locality makes them of great value.

Eleven insects from the Forest of Fontainebleau (April 1903) were presented by the Professor.

Two hundred and two insects of many Orders from Jamaica (1897–1903), of which no less than 182 have been catalogued as permanent accessions, were presented by C. B. Taylor, Esq., of Kingston, Jamaica, together with one Argynnid butterfly from Virginia, U.S.A., with injuries probably caused by the attack of an enemy. The data of time and locality are detailed, rendering the collection of especial value; inasmuch as the Jamaican specimens in the Department are very imperfect in this respect. The *Pierinae* include a splendid series of *Kricogonia lyside*, showing an extensive range of transitional variation; the *Papilioninae*, an interesting example of the rare and beautiful *P. homerus*, showing injuries which Mr. Taylor considers are undoubtedly due to the attacks of a lizard. Among the *Sphingidae* are two very distinct species exhibiting superficial resemblance of a very remarkable kind, which requires further investigation. The collection also includes examples of Hymenopterous models and Dipterous mimics. The Department owes to the generous donor an accession of remarkable interest and value.

A fine set of 848 insects of many Orders from Cyprus (1901–2), of which 547 have been catalogued and permanently added to the collection, was presented by Miss Dorothea M. A. Bate. The thanks of the University are also due to Colonel C. T. Bingham, for kindly suggesting the needs of the Hope Department to the generous donor. The butterflies include four specimens of *Limnas chrysippus*, a very interesting accession, from a locality hitherto unrepresented in the great series of this species in the Hope Department. An interesting divergence is exhibited in this little series, three specimens being dark Ethiopian forms, and the fourth showing a tendency towards the paler Oriental type. Among the moths are many taken at "Sugar" in the pine forest, at Asprokremnos, Troados, at a height of 4,675 feet. The Hymenoptera Aculeata have been kindly determined by Mr. Edward Saunders, F.R.S. The specimens, for the most part, possess excellent data, and they form a most interesting and valuable addition to the important part of the University Collection which illustrates the insect fauna of the Mediterranean.

A considerable part of the magnificent collection of butterflies from the shores of Lake Victoria Nyanza, made and presented in 1903 by C. A. Wiggins, Esq., has been catalogued and incorporated, but much still remains to be done, and must be deferred until the issue of the Report for the present year. The collection has been dealt with in sections according to the localities.

1. The Tiriki Hills (5,100 ft.), 20 miles N. of Kisumu on the N.E. shore of the Lake. Forest and Woodland. March, 1903. Seven hundred and fifty-one butterflies came from this locality, of which 404 have been catalogued and incorporated, and a large proportion of the remainder provisionally added to the collection. The *Danainae* include a fine series of *Melinda formosa* and an example of *Amauris niavius*, beautifully intermediate between the western and eastern forms, thus supporting the view of Professor Aurivillius that the two are a single species. The *Acraeinae* are numerous and include many extremely fine species new to the collection.

Among the *Pierinae*, *Mylothris tirikensis*, Neave, has been described.

2. Nyangori (5,000 ft.), 6 miles S. of the Equator, on the road to Nandi, near Kisumu. Forest. Nov. 1902 and April 1903. Seven hundred and eighty-three Lepidoptera, almost exclusively butterflies, came from this locality, and 461 have been catalogued, and many others provisionally added to the collection. The finest insect in this very fine series is a mimetic *Papilio*, intermediate between *P. rex* and *P. mimeticus*. Of this splendid form 3 ♂ and 2 ♀ were present. Many specimens of the western form of *Papilio dardanus* are also included, the females being of the *hippocoon* form.

3. Ugaia, and between Ugaia and Kisingiri (3,800 ft.), S. Kavirondo, on the N.E. shore of the Lake. Jan. 1903. Four hundred and fifty-seven butterflies, of which 285 are catalogued and many more provisionally added, came from this locality. The *Pierinae* are especially fine and numerous (164 specimens). One specimen of the beautiful Danaine butterfly, *Melinda formosa*, was present, while the *Papilioninae* included the remarkable *P. nobilis*.

4. Entebbe (4,000 ft.), on the N.W. shore of the Lake. Plain, with patches of forest. Early April 1903. Five hundred and seventy-seven butterflies were captured, but as they had become much injured by mould, rather less than half (271) were catalogued as permanent accessions. The Danainae included *Melinda mercedonia*, and the *Acraeinae* contained many species hitherto unrepresented in the collection. Among the *Papilioninae*, Mr. S. A. Neave described as new *Papilio gallienus peculiaris* and *P. gallienus whitnalli*. A small series of 17 butterflies, collected by Major Rattray in the same locality (June 1902), was given to Mr. Wiggins, and presented by him to the Hope Department. Nine of these have been catalogued and incorporated.

It has already been stated that this splendid accession is only partially catalogued, but the above four sections will convey some idea of its importance.

Ten butterflies from S. Ethiopia were received in exchange

from the Zoological Museum, Tring. They were collected, 1900–1901, in the expedition of O. Neumann (*Geogr. Journ.*, Oct. 1902), and are nearly all of great value as species, and all on account of locality.

Additions to the British Collections in 1903.

[*When the year is not given* 1903 *is to be understood.*]

A specimen of the beetle *Clytus arietis*, from the Botanical Gardens (June), presented by the captor, A. M. Bell, Esq., M.A., Balliol College.

The beetle *Necrophorus ruspator*, from Cumnor (July), presented by the captor, Miss Mabel E. Notley, Lady Margaret Hall.

The moth *Cerigo cytherea*, found in the University Museum (July 27), presented by the captor, Miss Cora B. Sanders, Lady Margaret Hall.

The rare fly *Volucella inanis*, found (Aug. 29) at the entrance of a wasp's nest in the garden of Pen Wartha, Weston-super-Mare, presented by the captor, Dr. W. Hatchett Jackson, D.Sc., M.A., Keble College.

The butterfly *Erebia blandina*, from Arisaig, W. Inverness (100 ft., Aug. 7), presented by the captor, G. C. Druce, Esq., Hon. M.A.

The butterfly *Arge galathea*, from near Burford (about 550 ft., July 29), and two Diptera from the University Observatory (1902), presented by the captor, F. A. Bellamy, Esq., Hon. M.A.

Three specimens of *Pyrameis cardui*, from Ingatestone, Essex (Oct. 4), presented by the captor, S. A. Neave, Esq., B.A., Magdalen College.

Five beetles found eating the dry roots of Aconite in the University Museum (June), presented by J. E. Marsh, Esq., M.A., Balliol College.

Four examples of *Vespa norvegica*, from a nest in the grounds of Cardean, Meigle, Perthshire, and the moth *Try-*

phaena pronuba, found in the house (July), presented by the captor, Miss Irene M. Cox.

A Chrysid and 2 beetles, from Felixstowe (July); 4 insects, from Oxford; 3 from St. Helens, Isle of Wight (various months in 1903); 34 from the grounds or in the neighbourhood of Cardean, Meigle, Perthshire (July); 21 from the neighbourhood of Edinburgh,—Roslyn, Hawthorndene, the Botanical Gardens at Inverleith (July); presented by the captor, the Professor.

Two Diptera (*Bibio*) from the University Park (May); presented by the captor, Martin Collier.

The following valuable additions to the British Collections are due to the kind help of Colonel J. W. Yerbury:—

Eighteen Coleoptera and 6 Rhynchota, from Woolmer Forest, near Petersfield (July 12).

Seventy-four Coleoptera, from Barmouth (April 29–May 12, 1902).

A variety of insects of several Orders—69 in number—from many localities in Herefordshire and Wales (1902), and from Torcross, S. Devon (1903).

Colonel Yerbury also presented the following interesting specimens, captured by himself, to the Bionomic Collection:—

Two pairs of *Empidae* (predaceous Diptera), captured *in coitu*, the female in each case devouring a Dipterous insect of another species; from Tarrington, Herefordshire (June 5, 1902).

A pair of *Asilidae* (predaceous Diptera), captured *in coitu*, the female devouring a Tipulid, from Barmouth (July 6, 1902).

A fine set of 54 insects, consisting of predaceous species, chiefly Diptera, and their prey, from various localities in Herefordshire, and from Barmouth (1902).

Two Hymenopterous models, and the Dipterous mimics captured with them: Herefordshire (1902).

A very fine set of 243 British beetles and 72 insects of various Orders, from a great variety of localities, were presented by Horace St. J. K. Donisthorpe, Esq. They include 3 insects taken in London. The full and exact data, together with the number of the localities, have been a severe strain upon the time of the Department; but the results are most satisfactory.

Largely owing to Mr. Donisthorpe's kind help the material for a most valuable collection of British beetles is being gradually accumulated.

One hundred and sixty-five Homoptera, captured at various dates in many localities, chiefly near Reading and Oxford, were presented by Mr. W. Holland of the Hope Department. The whole collection has been examined by Mr. Edward Saunders, F.R.S., and nearly all the species determined. The names have now been recorded upon labels attached to the specimens.

Additions to the Collections in 1904.

A very fine and varied series of insects, chiefly Lepidoptera, from the most varied localities, and with exact data, was presented by Commander J. J. Walker, R.N. Large numbers of the species were new to the Collections, or only represented by a few specimens with very imperfect data, or even with none at all. This important and valuable accession is classified below by the localities of the specimens.

Two specimens of *Limnas chrysippus*, var. *alcippus*, from Porto Grande, Sao Vicente, Cape Verde Islands.

The Hope Collection contains a fine series of the white-hind-winged form *alcippus* from the tropical west coast of Africa. Commander Walker's donation shows the same variety extending into the Cape Verde Islands—an interesting contrast with the Canaries in which the type form of *chrysippus* prevails.

Sixty-four insects of various Orders, chiefly butterflies, from New Zealand (the great majority captured by the donor in 1901, 1902, or 1903). Twenty-four butterflies were separated out as part of the nucleus of a special antarctic collection. These deeply interesting islands have been hitherto almost unrepresented in the Hope Department. Some account of the collection in which these specimens were included has been published by Commander Walker in the "Entomologist's Monthly Magazine," 1904, pp. 68, 115, 117, 121, 151. In many of the following references this periodical will be indicated by the initials "E. M. M."

One hundred and eighteen insects (114 Lepidoptera and 4 Neuroptera) from the New Hebrides (1900. "E. M. M." 1902, p. 189). From various localities in the three islands, Espiritu Santo, Efate, and Malekula; from single localities in Eramango, Aneityum, and Epi. Also a specimen of the fine Noctuid moth *Phyllodes miskini*, collected (1900) by W. H. Rossiter, Esq.

Fifty-five butterflies and 5 dragon-flies from Noumea, N. Caledonia (1900. "E. M. M." 1902, p. 189).

Twenty-three butterflies from the Torres Islands, to the north of the New Hebrides. From the islands, Hiu, Lo, and Tegua. (Sept. 14–15, 1900. "E. M. M." 1902, p. 189).

Sixteen butterflies and 1 moth from Chepenehe, Lifu, in the Loyalty Islands (Aug. 16–18, 1900. "E. M. M." 1902, p. 189).

A set of 11 moths from the same locality, captured by Mr. Wright.

Four butterflies from Tahiti (March 29–May 19, 1883. "E. M. M." 1883, p. 94) including two very interesting and extreme wet-season forms of *Melanitis leda*, and *Atella gaberti*, new to the Collection.

Four butterflies from the Gilbert Islands, captured by naturalists on H.M.S. "Archer."

Four Danaine butterflies and 6 dragon-flies from the Banks Islands:—Vanua Lava, Valua, and Gaua (Sept. 9–12, 1900. "E. M. M." 1902, p. 189). Very few of these fine localities in the Pacific islands are represented by specimens in the Hope Museum, and the collection is most welcome.

Ninety-eight specimens—50 butterflies, 18 moths, 30 Neuroptera—from New South Wales, in the neighbourhood of Sydney (1900–1903). All have precise dates, and the great majority exact localities. Among these are:—Lilyvale, Oatley, Woy Woy, Jenolan Caves, Ryde, Bulli, Blue Mountains, Garden Island, Mittagong, National Park, Ourimbah. Many of the Lepidoptera are bred, the name of the food-plant and date of emergence being recorded. The moths include specimens of the "Bugong" (*Agrotis spina*) eaten by the natives. The Neuroptera include a fine set of Cicadas from

Sydney, and many beautiful examples of a *Mantispa* from the National Park.

Seventeen Lepidoptera captured at various dates in many widely separated localities in Australia, in part by Commander Walker himself, and in part given him by other naturalists, chiefly by G. A. Waterhouse, Esq., to whom the thanks of the University are due. They include some rare species much wanted by the Department, such as *Heteronympha banksi* (new to the Collection); *Carthaea saturnoides*, a Geometer with the aspect of a *Saturniid*, of great interest for that part of the bionomic series which illustrates the phenomena of mimicry; and two ♂ examples of *Hecatesia fenestrata*, the "whistling moth."

Eight Neuroptera, from Tasmania, from the neighbourhood of Hobart (1903).

Three butterflies from Semao Island, south-west of Timor (May, 1890. "E. M. M." 1891, p. 234), including a specimen of *Limnas chrysippus*, form *cratippus*, and a convergent form of *Salatura genutia*. This synaposematic pair is a most interesting addition to the Mimicry Collection.

A dark species of *Salatura* from Ternate (Nov. 22–24, 1891. "E. M. M." 1893, p. 29). This specimen forms, with a specimen of *Limnas* previously presented by Commander Walker, a pair parallel with that from Semao Island.

A specimen of *L. chrysippus* from Samboangan, Mindanao, Philippine Islands (Nov. 29–30, 1891. "E. M. M." 1893, p. 57).

A fine dry-season form of *Melanitis leda*, and a ♀ specimen of *Catopsilia crocale*, showing an interesting symmetrical injury probably caused by some enemy. From Hong Kong (1892. Trans. Ent. Soc. Lond., 1895, pp. 449, 464).

A specimen of *Papilio machaon hippocrates* from Japan, collected (1901) by C. D. Clark, Esq.

A specimen of *Precis vellida* and of *Deiopeia pulchella* from Direction Island, in the Cocos Keeling group (Jan. 13, 1904).

A Sphingid moth from Ceylon, captured on H.M.S. "Diadem" (Jan. 24, 1904).

A specimen of *Melanitis leda* captured on H.M.S. "Diadem,"

in the Indian Ocean, off Minikoi Island (Jan. 28, 1904). The capture of such an apparently weak-flying butterfly so far from land is of much interest, and enables us to understand its wide distribution.

Eight specimens of a species of *Teracolus* captured at Aden (February 3, 1904).

A specimen of the Euploeine butterfly, *Pramasa mitra*, from Mahe Island, in the Seychelles, captured by Lieutenant Constable, R.N. (1898–9). This deeply interesting outlying member of a compact Oriental group of butterflies is new to the Department.

A specimen of *Acraea equatorialis*, from Callao, Peru (1882–3. "E. M. M." 1881, p. 85).

One *Pyrameis terpsichore*, from Coquimbo, Chile (Oct. 1883. "E. M. M." 1883, p. 258).

Two *Lemonias albinus*, from Taboga Island, Panama Bay (1882. "E. M. M." 1883, p. 259).

One *Tithorea irene*, from Emperador, on the Panama Canal, near the summit of the Pacific slope, captured by Commander E. G. Bourke (1881).

Five Coleoptera from various localities, given to Commander Walker by Dr. Swale.

This valuable series of 467 specimens, all captured by the donor, unless otherwise stated, has necessitated the expenditure of a large amount of time in printing, the type requiring to be continually altered on account of the great numbers of localities and dates.

The following deeply interesting specimens were presented by G. F. Leigh, Esq., of Durban, Natal. Their immense importance from the point of view of mimicry and of polymorphism has been already explained (see p. 18). The quotations of pages, plates and figures refer to Mr. Leigh's paper in Trans. Ent. Soc., London, 1904, pp. 667–91, Plates XXXI, XXXII, where the great majority of the specimens are described, and many of them figured.

A variety of the female *Hypolimnas misippus*, captured near Durban (Jan., 1904) together with the 16 offspring reared

from its eggs (pp. 689, 690). The parent is an interesting form (XXXII, fig. 1) intermediate between the type and its variety *inaria*. Of the 16 offspring, 8 were females, and of these only one resembled the parent, and even this was a less well marked variety. Of the remainder, 4 were typical *misippus* and 3 typical *inaria*. Five of the females and 2 males are figured (XXXII, figs. 2–8).

A male and female of *Papilio dardanus*, var. *cenea*, captured *in coitu* near Durban (Sept. 18, 1902), together with 14 of their offspring—6 males, 6 females of the *cenea* var. and 2 females of the var. *hippocoonoides*. The parents are figured (XXXI, figs. 1, 2), with 6 of the female offspring (figs. 3–8. See also pp. 677–685). Three of the pupa-cases were also presented by Mr. Leigh.

A female of *Papilio dardanus*, var. *trophonius*, captured near Durban (Sept. 18, 1903), together with the 5 offspring reared from its eggs—3 males and 2 females of the *cenea* var. The whole of these individuals are figured (XXXI, figs. 9–14. See also pp. 685, 686).

Twelve offspring bred from a *trophonius* variety of the same species (which was watched laying the eggs but not captured), together with 2 of the pupa-cases and 3 dried pupae. Of the offspring 6 were males, 5 were *cenea* forms of female and 1 a *trophonius* female, like the parent.

Three males of the same species (Mar. 7, 1904), one *hippocoonoides* form of female (Mar. 8, 1904), captured by Mr. Leigh, near Durban, and a second example of the latter form caught by another naturalist.

The instructive collection of specimens of *Limnas chrysippus*, which is a special feature of the Department, received a fine accession through the kindness of A. G. Wileman, Esq., H.B.M. Consul for the District of Tainan, Anping, S. Formosa. The donation consists of a series of 36 specimens—largely bred, all with precise data in 1904—from the flat sandy deltas near Anping and Tainan. In addition to the above, 3 examples of the mimic, the female *Hypolimnas misippus*, from the same locality, as well as examples of model and mimic captured on the

same day—one of each on June 30 and July 7, and two of each on July 1. Also 4 specimens of *Salatura genutia* from Takow.

The splendid additions to the Hope Collection which the University owes, in 1904 as in so many years, to the generosity of Guy A. K. Marshall, Esq., are briefly described below. It is hoped that many of them will form part of the material of a memoir on the bionomics of South African insects, in continuation of Mr. Marshall's important publication in 1902 (Trans. Ent. Soc. Lond., 1902, pp. 287–584).

From the neighbourhood of Salisbury, Mashonaland (1903–4), 1 moth and 28 butterflies, including specimens captured *in coitu* of much interest for the study of preferential mating between varieties, and 12 examples of the genus *Precis*. Some of these latter are labelled as the "first" or "second" example seen in the season, and are thus of much interest for the study of the alternation of wet and dry phases of the species. Also 5 examples of butterflies injured probably by the attacks of enemies—for the bionomic series.

Of the highest interest and importance is a series of 5 dry-season offspring, 2 ♂ and 3 ♀, bred from the eggs laid by a wet-season female of *Precis antilope*, captured at Salisbury on March 5, 1904. All 5 bear the dates of hatching, pupation, and emergence. The whole series has been set to show the under-side of the wings, for the seasonal differences are thus best seen; while the parent of the same species, with its two offspring, bred by Mr. Marshall in 1902, are arranged to show the upper side.

From the same locality, 36 Hymenoptera to add to the very fine series already collected for the Department by Mr. Marshall; 8 Hemiptera; 1 Homopteron; 8 Orthoptera; 7 Coleoptera; 30 Odonata (Dragon-flies); 2 Dipterous parasites (*Tachinidae*) bred from the pupa of *Precis sesamus*. To add to the collection for the study and illustration of mimicry—14 members of the great Lycoid group; 1 Reduviid bug, a member of a striking black and red combination; 9 members (Nov. 1903) of the black white-marked Mutilloid group of Carabid and Cicindelid beetles; with an example of the

Hymenopterous primary model. Finally a beautiful little group of black red-tailed insects, including 2 different flies, a moth, and the Hymenopterous model.

During 1904 Mr. Marshall added largely to the invaluable collection of specimens, proving the nature of the struggle for existence in S. African insects, which he had presented to the Department in previous years. The donation in 1904 consists of 31 sets of insect-fragments carefully extracted from the crops or stomachs of birds and from the faeces of lizards and mammals. Ten of these sets of fragments were extracted from the following birds (omitting scientific names):—Drongo, Weaver, Great African Crake, Corn-crake, Lark, Bush Shrike, Fly-catcher, Glossy Starling, Finch, Woodpecker (July, 1903–July, 1904). Eleven sets were obtained from the faeces of lizards of various kinds, possibly in one case from a toad (Oct. 1903–Mar. 1904): ten from faeces of the mongoose (Nov. 1903–June 1904). The locality in every case was Salisbury, Rhodesia. In spite of the fragmentary character of the remains, Mr. Marshall has been able in nearly all cases to determine the species.

Further additions to the bionomic series from the neighbourhood of Salisbury, are:—A Lamellicorn beetle tasted and rejected by *Cercopithecus pygerythrus* (Oct. 1903); a *Bembex* sp. and its Dipterous prey (Oct. 1903); a dragon-fly and its prey—a Galerucid beetle (Apr. 1904); 7 Asilid flies and their prey—an Ichneumonid (Apr. 1904), 2 Acridians (Nov. and Dec. 1903), a Fossorial wasp (Oct. 1903), a Coprid beetle (Mar. 1904), a small moth (Oct. 1903), a fly (Nov. 1903).

The material bearing on two other observations of Mr. Marshall is also of deep interest from the same point of view: (1) a Locustid (*Hetrodes*), captured at Salisbury, April 2, 1904, in the act of devouring the larva of *Limnas chrysippus*; thus demonstrating one of the enemies of this highly protected much-mimicked species. (2) Three winged Termites found crawling on the ground after having been attacked by dragon-flies, and the whole of the abdomen eaten. Observed at Salisbury, at sunset, Nov. 12, 1903.

From Umtali (3,700 ft.), 2 Lycaenid butterflies, including *Pentila peucetia* (Dec. 1900), and a variety of *Crenis boisduvalii*, captured by H. Dobbie (April 7, 1901). From the Mpudzi River, Manica (3000 ft.), an ant-lion (Nov. 1901). From Mount Chirinda, Melsetter, Gazaland (4,500 ft.), 3 Lycaenid and 3 Hesperid butterflies. With the kind help of Mr. H. H. Druce these butterflies have been mostly named, but there remain one or two which are still uncertain, or may be new species.

From Bulawayo, 4 Hymenoptera Aculeata (Dec. 1903). From the Matoppo Mountains, near Bulawayo, 2 specimens of a large conspicuous Cantharid beetle and a beautifully mimetic Buprestid, captured on the same day (Jan. 1904).

From Bulawayo, 21 examples of the great Lycoid group, including many new to the fine set in the Department. Also from the same locality, 2 individuals of a Sesiid moth with hairy brightly-coloured legs, which are held so as in great part to cover the moth when at rest, and, as Mr. Marshall believes, produce the appearance of a conspicuous distasteful caterpillar.

Mr. G. A. K. Marshall has also presented a valuable series of co-types of many species described in his masterly monograph on the Curculionid genus *Hipporrhinus* (Proc. Zool. Soc., 1904, p. 134, &c.):—*H. gunningi* ♀ (Transvaal); *H. consors* ♂ ♀ (Transvaal); *H. deceptor* ♂ ♀ (Algoa Bay); *H. braunsi* ♂ (Orange River Colony); *H. vicinus* ♀ (Natal); *H. propinquus* ♂ ♀ (Salisbury); *H. bimaculatus* ♂ ♀ (Salisbury); *H. cervinus* ♂ (Orange River Colony); *H. angustus* ♂ (Algoa Bay); *H. errans* ♀ (Natal); *H. humeralis* ♂ (Little Namaqualand). Mr. Marshall also presented a ♂ and ♀ of *H. arenarius* (Fåhr.) from Bulawayo.

From Crete, Lassethe Plain (about 2,500 ft.), 3 *Thais cerisyi* (May 19–26, 1904); together with 8 *Coenonympha pamphilus*, var. *lyllus*, and 9 *Lycaena psylorita*, from the Nidtha Plain at a height of about 4,200 ft. on Mount Ida (July 2–3, 1904). Presented by the captor, Miss Dorothea M. A. Bate. The specimens are a welcome addition to the representatives of the Mediterranean insect fauna in the University Collection.

A very fine and valuable collection of butterflies from Macao, S.E. China, were presented by J. C. Kershaw, Esq. Through Mr. Kershaw's generosity the Department is rapidly acquiring a full and complete collection of butterflies from this most interesting part of the world. The data are precise and detailed, and the donation includes a long series of the species with profound seasonal changes, such as *Precis almana* and its entirely different wet form, *asterie*. Furthermore, the captures have, as far as possible, been effected right through the year; so that the replacement of one form by the other and the amount of overlap can be studied in the only way in which sound conclusions can be reached, viz. by the investigation of a large mass of material, carefully collected and accompanied by the fullest data. There are also included specimens by means of which Mr. Kershaw has proved that the well-known Euploeine butterfly, *Crastia godarti*, is a form of *C. amymone*. In spite of the conspicuous differences between these insects, Mr. Kershaw shows that they are connected at Macao by a long series of transitional forms, and he has now even succeeded in breeding one well-marked form from the other (Proc. Ent. Soc. Lond., 1904, p. lxxxvi).

Up to the present time 664 butterflies (the great majority captured in 1904), 1 moth, and 3 Coleoptera have been added to the Collection, together with 13 butterflies from Macao and 2 from Hong Kong, collected by the same naturalist, and presented by his brother, G. W. Kershaw, Esq.

Two male specimens of *Papilio laglaizei* and 2 specimens of its model, the Uraniid moth, *Alcidis aurora*, from Dutch New Guinea, were presented by the Zoological Museum, Tring. This is a most beautiful example of mimicry, new to the Bionomic Series. The colour of the under-side of the body of the moth is reproduced on the wings of the butterfly, tingeing the parts which probably cover the body of the mimic in the position of rest.

A specimen of *Papilio menestheus*, from the Gold Coast, was also presented by the same Museum.

A valuable little collection of 56 insects of various Orders,

captured by F. Butterworth, Esq., at Toowoomba, near Brisbane (Sept. 1902–April 1903), was presented by W. J. Lucas, Esq., B.A.

A very fine collection of over 2,000 insects of many Orders from the Malayan region was generously presented by E. L. Meyer, Esq. The exact localities are as follows:—

Two hundred and forty-seven specimens from the Philippine Islands:—near Paksanjan, Manila, Luzon, Feb. 20–22; Manila, March 15–31, and the end of March. Insects from the Philippines are particularly wanted by the University Collection.

Six hundred and forty-six specimens from Penang (early May), the Hills (May 26), the Plains (June 1–3). A very fine series from this interesting locality.

Two hundred and eighty specimens from the following localities in the Malay Peninsula:—Kwala Lumpur, Selangor, May 29–31; Kwala Kangsar, Perak, May 31–June 1, and on June 1 alone; Johore Bharu, Aug. 1.

A fine series of 430 insects of all Orders from Singapore (the Tanglin District), June 21–29, July 20–22, Aug. 8–13; ("The Gap," New Harbour Hills), Aug. 4, 1904.

The moths (161 in number) are particularly fine and in excellent condition, especially the small species, which are so difficult to obtain perfect.

Six specimens of a species of *Tabanus*, and a Reduviid bug, captured on the SS. "Prinz Waldemar" in the Banca Strait (Aug. 14).

Sixteen insects from Buitenzorg, at a height of 260 metres, Java (Aug. 15). The Department is unfortunately very poor in species from this interesting island.

Four hundred and nine specimens from the following localities in the deeply interesting and remarkable island, Celebes:—The Tello River, near Macassar, Aug. 21; the neighbourhood of the Koningsplein, Macassar, Aug. 22–23; Macassar, Aug. 23–26; Maros, two days inland from Macassar, Aug. 23–30; Pare Pare, on the west coast of Celebes, Aug. 27–28.

The series includes many butterflies greatly wanted by the Department, especially in the *Danainae* and *Elymniinae*. But

all the species are most welcome; for the Hope Collections have received hardly any specimens from Celebes since the small but interesting collection made by Professor S. J. Hickson, F.R.S., in 1886.

Two butterflies from Deli, Sumatra, collected (July) by H. Pickenpack, Esq., and a Cassidid beetle from Kwala Lumpur (of uncertain data) were also presented by E. L. Meyer, Esq.

Three hundred and eighty-nine Lepidoptera, almost exclusively butterflies, of which 218 have been catalogued and permanently added to the collection, were presented by the Rev. A. P. Hunt, of New York. Many more have also been added, at least provisionally. The data are full and precise. The chief localities are in the northern part of the Adirondack Range, but specimens were also taken in the White Mountains, N.H., and in several localities in the States of New York and New Jersey, and near Boston. The captures were made between 1901 and 1903, by far the largest number in the year last-named. The great majority were taken by the donor himself, but for many specimens, from the neighbourhood of Albany, N.Y., the thanks of the University are also due to J. Cook, Esq.

The collection includes a very fine series of *Grapta faunus*, one of the "Comma" butterflies of the United States, and the wide range of beautiful variations of the under-side is now splendidly shown in the cabinets of the Department. The fine series of forms of *Colias philodice* is a most welcome addition to the collection of *Pierinae*. There are also examples of *Anosia archippus*, the great Danaine intruder from the tropical south, together with its Nymphaline mimic, *Limenitis* (*Basilarchia*) *misippus*, captured together at the same place and time. These will find a place in the bionomic section of the Department. The whole accession is of the greatest value and will do much to render the collection more serviceable to North American students.

Two hundred and fifty-two insects, almost entirely Lepidoptera, from Concepcion, Tucuman Province, N.W. Argentina (1904), were presented by Stewart Shipton, Esq., B.A., of

Lincoln College. The locality is especially well placed for the study of the southward drift of tropical S. American forms, and the collection is of great interest from this point of view; although it also includes many species new to the University Collection. 175 specimens have been catalogued as permanent accessions and many more provisionally added to the collection.

A very valuable and deeply interesting set of 25 Lepidoptera, from W. and S.W. China and from Sikkim, was presented by Monsieur Charles Oberthür, of Rennes. The specimens raise problems of the greatest difficulty and interest concerning the mimetic resemblances of the northern belt and the influence exerted upon them by the products of the tropical south.

The series contains examples of an Erycinid butterfly, *Stiboges nymphidia*, and of its mimic *Abraxas nymphidiaria*, a Geometrid moth. These latter are of much interest when placed beside specimens of *Abraxas etridoides*, the Southern Indian mimic of a *Teracolus*. A fine series of this latter mimic also has recently been acquired by the Department (see p. 567). Both mimics are probably protected by taste or smell, and their near ally in this country, *Abraxas grosulariata*, has been proved by many experiments to be distasteful to insect-eating animals.

Another beautiful group consists of a butterfly model, *Timelaea albescens*, with two mimics belonging to entirely different sections of moths: *Obeida leopardaria* and *Botys rhyparialis*.

Another example, *Hestina oberthüri* and *Limenitis cottini*, shows the tendency of species of very different genera—both conspicuous and probably distasteful—to resemble each other.

One of the finest mimetic groups in the north of India and Burmah is that which surrounds the Danaine butterfly, *Caduga tytia*. One of the most beautiful and by far the rarest member is *Neptis imitans*, which now, owing to the generosity of Monsieur Oberthür, finds a place in the University Collection, together with another member, a form of *Papilio agestor*, from a locality new to us (Siao-lou, near Ta-tsien-lu, Szu-chuan).

Finally, there are four examples of *Limenitis albomaculata*

and four of *Athyma punctata*, both beautiful mimics on both upper- and under-sides of the male of *Hypolimnas misippus*, a model which is abundant far away to the South in the tropics, but becomes much rarer in N. India, and in all the 25 years of Monsieur Oberthür's experience has never been known in W. China, where the mimics are found. We are driven to suggest two alternative hypotheses: (1) that the model, which is known to be a wide-ranging insect with immense powers of flight, has visited W. China sufficiently often and for sufficiently long periods to render the mimetic resemblance advantageous. Against this it may be urged that *H. misippus* is a tropical butterfly, and that it is improbable that it would reach or, at any rate, establish itself in such a latitude at such an elevation as e.g. Ta-tsien-lu; (2) a more probable hypothesis is afforded by the lines of migratory birds, applying in the temperate zone, where they nest, the experience learnt in the tropics. If a bird's experience of the male of *H. misippus* be an unpleasant one, it follows that a modification in the pattern of any butterfly which suggests the same experience and leads to a cautious attack or perhaps averts attack altogether, will be advantageous. All that is necessary is that the same enemy should see the two insects. If this be achieved it matters not how many hundreds of miles may intervene between model and mimic. The two northern mimics belong to genera which have in their colours and patterns considerable resemblance to those of the model; so that it is possible to understand why this species instead of any other distasteful resident in the tropics, has been imitated. The hypothesis suggests inquiry into the species of migratory birds, the routes followed, and dates of arrival and departure.

It will be realized that these 25 specimens bear in the most interesting manner upon the very questions which, more than all others, are studied in the Hope Department.

Twenty-five insects of various Orders from St. Moritz and Ragatz (July 1903) were presented by the captor, Hamilton H. Druce, Esq.

Seven insects belonging to three Orders from Langö, one of the Western Lofoden Islands (1904), were presented by the captor, E. N. Bennett, Esq., M.A., Hertford College.

Five Hepialid moths from Launceston, Tasmania (Feb., 1903), were presented by — Littler, Esq.

A Pyralid moth from Queensland was presented by J. R. Hardy, Esq., of the Manchester Museum.

A specimen of *Tulbaghia meneris* from S. Africa was presented by S. A. Neave, Esq., B.A., Magdalen College.

One hundred and forty-three insects of various Orders (of which 113 have been catalogued) from British East Africa (1902-4) were presented by S. L. Hinde, Esq. and Mrs. Hinde. The localities and elevations (approximate) are of much interest: Fort Hall (4,000 ft.), Niro River (8,000 ft.), above Gouro River (7,000 ft.), Aberdare Mountains (8–10,000 ft.). All are in the Kenya Province. Many of the specimens are the material upon which interesting observations have been made by the donors. Several of the Lepidoptera have been bred from the egg, and the larvae painted by Mrs. Hinde, who has also recorded the dates of pupation, emergence of imago, &c. Among the accessions to the collection three specimens of *Acraea excelsior* and one of *A. astrigera* were especially welcome, together with a fine series of a Passalid beetle, probably a new species, captured at 9,000 ft. on the Aberdare Range. But the localities and precise dates render the whole an accession of great value.

Three hundred and thirty-four Lepidoptera, chiefly butterflies, almost exclusively from the Eastern part of British East Africa (1903–4), were presented by the captor, the Rev. K. St. Aubyn Rogers, M.A., Wadham College. The localities are Mombasa, Taita Plain, Dabida Mountain, Sagalla Mountain, and the Voi River, about 100 miles N.W. of Mombasa; Rabai, 14 miles N.W. of Mombasa; Ndzovani, 30 miles N. of Rabai; and Nairobi in the Kikuyu country. The Department has rarely received a collection of which so large a proportion of the species were greatly needed, and 300 out of 334 have been catalogued as permanent accessions. The *Nymphalinae*,

Acraeinae, *Lycaenidae*, and *Pierinae* were especially rich in species unrepresented in the cabinets of the Department, or represented by few individuals from different localities or without data. In addition to these 334 specimens, many others sent by the same kind donor await the answers to inquiries concerning locality before being labelled and catalogued.

One hundred and ninety-seven Lepidoptera, chiefly butterflies, from British Central Africa, of which 105 have been catalogued, were presented by H. A. Byatt, Esq., B.A., Lincoln College. The specimens, which possess excellent data, were captured in 1903 and 1904 in a variety of localities and at many different elevations. Among the *Acraeinae* were three specimens of a new species which Mr. S. A. Neave described as *A. byatti*, but his description was anticipated—by a few weeks only—by a continental naturalist, and *byatti* becomes a synonym of *goetzei*, Thur. Of much interest for the bionomic collection is a series of *Papilio leonidas*, captured at the same time and place with the Danaine butterfly, which it resembles—*Tirumala petiverana*. Some of Mr. Byatt's specimens have been exhibited at meetings of the Entomological Society of London, and his observations published in the "Proceedings."

Additions to the British Collections in 1904.

A splendid set of 656 British Diptera was presented by Col. J. W. Yerbury. The species have all been accurately worked out by the donor, and the names as well as the localities and dates are now recorded on the specimens. The captures were made over a very wide area, as the following list of counties, &c., indicates :—Inverness (1898), Elgin (1899), Sutherland (1899, 1900), Haddington (1899), Perthshire (1898), Caithness (1899, 1900), N. Wales (1902), S. Wales (1899, 1903), Hereford (1899, 1901, 1902), S. Devon (1903), Hampshire (1898), Surrey (1899, 1900, 1903), Sussex (1900), Kent (1898, 1899), Cambridge (1898).

An interesting series of Diptera with their prey (10 specimens) from Torcross, S. Devon (Aug.–Sept. 1903), was also

presented by Col. Yerbury, together with 2 Hymenoptera Aculeata from Kent and Woolmer Forest.

A fine set of 106 British Coleoptera from the most varied localities, with excellent and precise data, was presented by Horace A. Donisthorpe, Esq.

Five fine specimens of *Grapta C.-album*, illustrating the seasonal variation of the species in England, bred, about 1889, by Mrs. E. S. Hutchinson, at Leominster. Presented by Commander J. J. Walker, R.N.

Twenty-eight specimens from Barton Mill, Suffolk; Wicken Fen; and Teignmouth (1900–1901), were presented by the captor, Mr. A. H. Hamm. They consist of groups of synaposematic Hymenoptera and mimetic Diptera, each assemblage captured at one time upon a single patch of flowers. They are an interesting addition to the bionomic part of the collection.

Two moths taken at Ivy-bloom (1904) at Mortehoe, N. Devon, were presented by the captor, G. B. Longstaff, Esq., D.M., New College.

Three insects from St. Helens, Isle of Wight, were presented by the Professor.

Very interesting evidence of the attacks of birds was supplied by Mr. Fred Birch in a specimen of *Thecla quercus* from Arnside Knott, near Grange, Lancashire (Aug. 1898). A bird was seen to dart at the spot where the butterfly was settled, and the insect, when captured, exhibited symmetrical injuries, such as would be caused by a snip taken out of both wings when in contact in the position of rest.

Similar indirect evidence is very finely exhibited by a specimen of *Papilio machaon*, in which a snip has been taken out of all four wings at the precise spot in the margin where alone this is possible as the result of a single injury, viz. where the fore and hind wings overlap and come into contact with the corresponding parts of the opposite side. The specimen was taken in the Norfolk Broads, in June, 1903, by the donor, A. Lofthouse, Esq., who observed the injury on the specimen before capture.

An Asilid fly and its prey, captured at Walton, Surrey, on

Aug. 8, 1903, by H. A. Saunders, Esq., B.A., Keble College, was presented by Edward Saunders, Esq., F.R.S.

Two dark varieties (the var. *capucina*) of the Noctuid moth, *Miscelia oxyacanthae*, bred in 1902 from larvae taken at Loughton, Essex, were presented by Selwyn Image, Esq., M.A., New College.

The following specimens taken in 1904 in Oxford or its neighbourhood were presented by the captors:

The beetle, *Pyrochroa serraticornis*, by F. A. Bellamy, Esq., Hon. M.A.

The "buff-tip" moth, *Pygaera bucephala*, by Miss Harrison.

The "cabbage moth," *Mamestra brassicae*, taken in the University Museum, by F. A. Dixey, Esq., D.M., Wadham College.

An Ichneumonid, by W. M. Geldart, Esq., M.A., Trinity College.

An Ichneumonid and a Dipterous insect, by E. A. Cockayne, Esq., B.A., Balliol College.

Nineteen insects of various Orders, from several localities near Oxford, by the Professor.

A specimen of *Sphinx convolvuli*, by R. H. Life, Esq.

An interesting example of *Smerinthus ocellatus* with a similar slight deformity in each of the four wings, by the Rev. J. W. B. Bell, M.A., Wadham College. The specimen was bred June 15, 1904, at Pyrton. The appearance suggests a slight injury suffered in the larval or pupal stage.

A large Lycosid spider, found alive, and probably introduced accidentally with bananas or other fruit, by Mr. J. Townsend.

One of the plume-moths, found in the University Museum, by Mr. A. Robinson.

Nine insects of 5 different Orders, from various localities near Oxford, by J. E. Pogson Smith.

Very interesting evidence of the struggle for life waged by insects is supplied by a set of 19 fragments (wings) of moths dropped by bats upon the floor of Professor Miers's rooms at Magdalen College.

Eighty-five insects of various Orders, from many localities near Oxford, by Mr. W. Holland.

Five dragon-flies, by Mr. A. H. Hamm.

A larva of *Cossus ligniperda* (the goat moth) found in the Lamb and Flag Yard, and purchased in 1903 of Thomas Howse, produced a moth on June 22, 1904.

PURCHASES IN 1904.

A hundred and forty-four Lepidoptera from Chubut, Valley of Lago Blanco, in the Patagonian Andes, near the Chilian frontier, were purchased from W. F. Rosenberg. Twenty-four of the butterflies were separated out to form with other accessions the nucleus of a special Antarctic Collection. The whole series was greatly wanted on account of the locality.

The following specimens purchased at Stevens's auction room are now catalogued and incorporated :—

Ninety-four Lepidoptera from Sapucay, Paraguay (1900–1903). The majority bear exact dates.

Two hundred and thirty-seven moths (of which 194 are catalogued) from Tuis, at a height of 650 metres, on the Atlantic slope of Costa Rica.

Three hundred and ninety-one Lepidoptera (of which 316 are catalogued) from Gooty, in the South of India. This series contains 11 examples of the Geometrid moth *Abraxas etridoides*, a beautiful mimic of the butterfly, *Teracolus etrida.*

THE HOPE LIBRARY.

Miss Bellamy has nearly completed the slips and has begun to make a card catalogue which will be of the utmost value. In the autumn Dr. F. A. Dixey began to classify the books and has already finished a large part of the work—indeed probably the most arduous part of it. He has also undertaken a general superintendence of the work, which under his guidance has made great progress. It is hoped that the day is not far off when the Library will be in the possession of a really efficient and complete catalogue.

A certain amount of binding has been done, but a very small fraction of what is required in order to overtake the vast arrears.

A gift of peculiar interest has been made by Mr. Edward M. Langley, of Bedford, viz. the interleaved copy of Jussieu's "Genera Plantarum" (ed. Usteri, Zurich, 1791), which was carried by W. J. Burchell in his travels in South Africa and in Brazil. The following words are written in Burchell's handwriting on the inside of the cover:—

> "Hunc librum in itineribus suis
> in Africa australi annis 1810 ad 1815
> et in Brasilia annis 1825 ad 1830 semper
> secum habuit Gulielm. Johan. Burchell."

Many pencilled notes and numbers in Burchell's handwriting occur throughout the book, but the Latin inscription is in ink, and the writing so fresh and black that it must have been inserted late in the lifetime of the great naturalist—perhaps an indication that he foresaw the interest which would at some future date be felt in his life and work. The evidence derived from Burchell's handwriting is confirmed by reference to page 165 of his "Travels in the Interior of South Africa" (vol. i, London, 1822), where among "the contents of my waggon when it left Cape Town" on June 18, 1811, we find "Jussieu, Genera Plantarum, ed. Usteri."

The Hope Library contains a set of the publications of the Société Entomologique de France complete from the birth of the Society in 1832 until the death of Professor Westwood in 1892. The present Professor having recently become a life-member of the French Society, was entitled to receive 10 volumes of the older publications, but not for the years which are wanting. This difficulty has been overcome by the generous decision of the Council, conveyed in the following statement by the Treasurer, Monsieur Ch. Lahaussois:—"J'ai le plaisir aujourd'hui . . . de vous annoncer que le Conseil, par décision gracieuse, a décidé de vous remettre, non pas cinq années, mais les *10 années* d'Annales 1893, 4,

5, 6, 7, 8, 9, 1900, 1901 et 1902, qui manquent à votre bibliothèque ; vous allez prochainement les recevoir, avec les trimestres 1er et 4^{e} de 1892, et vous aurez ainsi la série complète depuis le décès du regretté professeur Westwood."

It is hoped that the volumes of Hope Reports which are presented by the Department to the Society will prove to be in some measure a return for the kindness of the Council in making a special concession to the Department Library.

The fine series of volumes of the Transactions of the Entomological Society of London, presented by Mr. G. A. James Rothney, has already been mentioned (see p. 19).

The Boston Society of Natural History and the Bombay Natural History Society presented their publications for the year 1904.

The volumes of the "Novitates Zoologicae" of the Tring Zoological Museum, published in the year 1904, were presented by the Hon. Walter Rothschild.

Many volumes of the Philosophical Transactions between 1802 and 1857 (70 separate parts, &c.) were presented by the Master of University College, thus greatly assisting towards the completion of the imperfect set in the Department Library.

The publications of the Linnean Society for the year 1904 and the Transactions of the Entomological Society of London for 1904 were presented by the Professor.

The following Reports, &c., were presented :—

Bristol University College : Report of Council for 1903-4.

Cambridge University : Thirty-seventh Annual Report for 1902 and the Thirty-eighth Report for 1903 of the Museum and Lecture-rooms Syndicate.

Cornell University : College of Agriculture, Bulletin 214, by M. V. Slingerland, Esq. and Miss Philena B. Fletcher ; Bulletin 215, by M. V. Slingerland, Esq.

Harvard College : Two memoirs on Heredity, by Dr. W. E. Castle.

Ottawa : Report of Government Experimental Farms for 1903, together with three memoirs by the following authors : (1) Dr. J. H. Grisdale, F. T. Shuth, Esq., and J. Fletcher, Esq. ;

(2) Dr. W. Saunders and C. E. Saunders, Esq.; (3) Dr. W. Saunders.

Owens College: The Report of the Manchester Museum for 1903–4.

The Radcliffe Library: The Catalogue of Books added to the Library, 1903–4.

Sarawak Museum: The Report for 1903.

The following valuable works were presented by the Trustees of the British Museum:—

First Report (1903) and Second Report (1904) on Economic Entomology, and A Monograph of the Culicidae or Mosquitoes, vol. iii, by F. V. Theobald, Esq.

Two Orders of the Arachnida—Opiliones and Ricinulci (1904), by Dr. H. J. Hansen and Dr. W. Sorensen.

Catalogue of the Collection of Palaearctic Butterflies formed by the late John Henry Leech (1902), by Richard South, Esq.

Catalogue of the Noctuidae in the Collection of the British Museum, vol. iv, and Plates (1904), by Sir George F. Hampson.

Instructions for Collecting Insects.

The Smithsonian Institution (United States National Museum, Washington) presented valuable memoirs by the following writers:—Philip R. Uhler, Esq.; James A. G. Rehn, Esq. (two memoirs); Miss Florence E. Bemis; Carl F. Baker, Esq.; Nathan Banks, Esq.; Miss Harriet Richardson (two memoirs); Prof. D. S. Jordan and E. C. Starks, Esq.; C. C. Nutting, Esq.; C. B. Wilson, Esq.; Dr. Harrison G. Dyar; A. N. Caudell, Esq.; August Busck, Esq.; James G. Needham, Esq.; J. E. Benedict, Esq.

"Fasciculi Malayenses," Part II, Zoology, and Part II (*a*), Anthropology (1903–4), were presented by the editors, Nelson Annandale, Esq., B.A., Balliol College, and Herbert C. Robinson, Esq.

Professor Chr. Aurivillius, of Stockholm, presented three memoirs.

Four memoirs were presented by G. T. Bethune-Baker, Esq.

H. St. J. K. Donisthorpe, Esq., presented a copy of the

Catalogue of British Coleoptera (1904), by himself and Professor T. Hudson Beare.

Herbert Druce, Esq., F.L.S., F.Z.S., &c., presented four memoirs.

A paper by Dr. W. J. Holland, on Bahaman Lepidoptera, was presented by H. S. Gladstone, Esq.

Two Fasciculi (the 21st and 23rd) of the great monograph on the Phytophaga by M. Jacoby and H. Clavereau, in Wytsman's "Genera," and one by M. Jacoby, were presented by M. Jacoby, Esq., together with two other memoirs.

The important Monograph on the Coleoptera of the genus Hipporrhinus (Proc. Zool. Soc., 1904) was presented by the author, Guy A. K. Marshall, Esq.

Professor August Weismann's volume upon the Daphidae (Leipzig, 1876–9) was presented by Professor R. Meldola, F.R.S.

Monsieur Charles Oberthür presented Fasciculus I of "Études de Lepidopterologie comparée" (Rennes, 1904).

The "Record of my Life Work in Entomology, Part III, list of my Entomological publications from 1854–1904," was presented by the author, Baron C. R. Osten-Sacken.

A valuable collection of nine memoirs on Hymenoptera (1889–1904), by Peter Cameron, Esq., was presented by G. A. J. Rothney, Esq. Mr. Rothney's generous gift of forty-two volumes of the Transactions of the Entomological Society has been acknowledged in an earlier part of this Report.

Monsieur M. J. Vachal presented a valuable series of twelve memoirs, published between 1897 and 1904. They constitute an important addition to the section of the Hope Library devoted to the Hymenoptera.

Original papers have also been presented by the following authors:—Nelson Annandale, Esq., B.A., Balliol College; E. E. Austen, Esq. (two memoirs); Wm. Eagle Clarke, Esq.; W. E. Collinge, Esq. (two memoirs); Hamilton H. Druce, Esq. (two memoirs); Rev. A. E. Eaton; Willoughby Gardner, Esq.; John Hopkinson, Esq.; W. S. Marshall, Esq., and

A. Severin, Esq.; C. W. Prentiss, Esq.; Edward Saunders, Esq., F.R.S. (three memoirs); Miss E. M. Sharpe; R. W. C. Shelford, Esq. (two memoirs, one including a note by Col. C. T. Bingham); Mark L. Sykes, Esq.; W. L. Tower, Esq. (two memoirs); Commander J. J. Walker (two memoirs); W. Wesché, Esq.

PURCHASES.

The following publications of the year 1904 were purchased for the Department:—The parts of Barrett's "British Lepidoptera," the Ray Society volume, the volume of the Zoological Record, the numbers of the "Entomologist's Monthly Magazine," the "Entomologist," and the "Entomologist's Record."

In addition to the above—the normal expenditure for many years—the following purchases were made:—"A Natural History of the British Lepidoptera," by J. W. Tutt, vols. i–iv. Fasciculi V, VII, VIII and X of E. F. Germar's "Augusti Ahrensii Fauna Insectorum Europae," and a few odd parts of Donovan's "British Insects" and of the Zoological Journal.

E. B. POULTON.

Report of the Hope Professor of Zoology, 1905.

It has been customary in previous years to present a summary of the chief accessions acknowledged in detail in the later pages of the Report. The growing length of these Reports, owing to the increased number of workers in the Department, and of donors who add to its resources, renders it expedient to omit any section that is not absolutely necessary. This summary is therefore omitted. A full account—on this occasion longer than ever before—of the catalogued donations, under their respective years up to and including 1905, occupies by far the largest part of this Report.

Hardly any mention has been made of uncatalogued donations. This is because the increase in the staff encourages the hope that all outstanding gifts not hitherto provisionally recorded will be catalogued and formally acknowledged next year.

Financial gifts and grants to the Department.

The perennial difficulty caused by want of cabinet space has been temporarily relieved by the purchase, for £200, of 530 well-made drawers from Mr. W. Schaus, F.Z.S. I desire gratefully to acknowledge the great generosity with which Mr. Schaus treated the University in this matter. The Professor contributed half of the necessary sum for this purchase.

Dr. G. B. Longstaff's kind assistance, enabling the Department to add another Assistant to its staff for two years, was acknowledged in the last Report. Mr. J. Collins has now been working for over a year, and the Department has had full practical experience of the great relief afforded by this generous gift.

The University, in 1904, was unable to increase the annual grant by £100, as had been hoped, but provided an additional £50 for the year in question. In 1904 this was raised to £100, now assured by decree for three years. The wide conditions of the grant "for assistance and other expenses of

the Department," add to the value of the annual increase. Although such a sum cannot be expected to do much in bearing the great burden of the purchase of cabinets, in all other respects it is and will be of the greatest help to the Department.

Early in the year Dr. Henry Wilde, Hon. D.C.L., D.Sc., F.R.S., generously gave £100 for the purchase, arrangement, and display of material illustrating Protective Resemblance and Mimicry in Insects.

The assignment by the Delegates of the Museum of a sum of money from the Magdalen College grant is spoken of in the succeeding section.

Work done by the Staff.

It has been a great pleasure to welcome Mr. R. Shelford, M.A., F.L.S., Emmanuel College, Cambridge, as one of the workers in the Hope Department, on his return from a seven years' residence in the tropics as Curator of the Sarawak Museum, at Kuching, Borneo. This important help in the work of the Department has been rendered possible by the assignment, by the Delegates of the Museum, of a portion of the generous grant made by Magdalen College, for scientific assistance. Mr. Shelford at once took control of the Hope Library, and began the great work of introducing order into the collection of Orthoptera. The University Collection of these important insects is one of the great collections of the world, but hitherto it has been of little use: its material scattered in various separate collections—the combined Hope and Westwood Collections, the W. W. Saunders, Miers, Burchell, the recently presented Malcolm Burr, and recently purchased De Bormans, Collections. In addition to these collections in which (except for the W. W. Saunders and De Bormans Collections) comparatively few of the specimens bear trustworthy determinations, there are large numbers of accessions from many donors and many countries, and these, with the exception of a small but valuable group, presented in 1902 by Señor Don Ignacio Bolivar, are entirely without

names. When Mr. G. A. K. Marshall was in England in 1904, he and the Professor attempted to name the Burchell African Orthoptera by comparison with the chief collections mentioned above. The attempt was not only useless, but induced a feeling almost of hopelessness at the amount of work which required to be done. In a few months that feeling has been entirely dispelled. The important group of the *Blattidae* ("cockroaches") has already been arranged as a whole, the material having been drawn together by Mr. Shelford from all the sources mentioned above, each of which is indicated on the separate specimens. The whole occupies 45 cabinet drawers, and includes nearly 2,500 specimens grouped under 122 genera and 708 species of which nearly half have been accurately determined. Of the remainder about 150 are certainly new species, of which many, already described by Mr. Shelford, await publication in the near future. Already the collection from having been (except for its types) almost useless, has become a source of assistance to other Museums, the means for naming *Blattidae* in the Paris Museum and the Sarawak Museum.

The materials of the next great group, the *Mantidae*, are being brought together and labelled for similar treatment.

The largest piece of work carried out by Mr. W. Holland was the careful arrangement of the *Lycaenidae* or "Blues," all of which had been named by Mr. Hamilton H. Druce, the distinguished authority on the group. The family now occupies 84 drawers, and the species being small, an immense amount of labour has been necessary for the arrangement of the labels as well as the specimens.

Much time was also occupied in incorporating accessions, in looking out types for the study of specialists, and returning them to their places. Another important piece of work was the renewed search through the Coleoptera for types, which when found were carefully labelled, and entered in the special book. Many types were recovered in consequence of an inquiry for them by eminent specialists who knew that they should be in the University Collection. In these difficult

cases, when the specimens were finally recovered it was found that they had been quite insufficiently labelled by the original author. In this way the assistance given to others has been the direct means of rendering the collections more valuable and efficient.

The *Papilioninae* and the *Hesperidae* are the only butterflies which now await arrangement. The work necessary for naming the former was nearly completed some years ago, while Dr. F. D. Godman, Hon. D.C.L., F.R.S., has kindly consented to name the South American Hesperids, and Mr. Hamilton H. Druce those of the remaining Regions. The completion of the arrangement of the most popular group of insects, the butterflies, is therefore near at hand. But while one part is being arranged the others are rapidly growing, so that a certain amount of adjustment and re-arrangement will always be necessary.

Another large piece of work has been the removal of a part of the classical W. W. Saunders collection of moths from the dangerous store-boxes in which they were placed by their original owner. The group dealt with contains the South American *Geometridae*: these now occupy 28 cabinet drawers, and the old and fragile specimens, liable to be blown to pieces by the draught every time an old store-box was opened, are now comparatively secure. This part of the collection contains the original types of about 200 species. These specimens, which are of priceless value to the systematic naturalist, have been all conspicuously labelled by Mr. Holland. Similar treatment of the whole Saunders Collection is a pressing need.

Furthermore, the Oriental *Cicindelidae* ("Tiger-beetles") had to be disentangled from the Collection for Canon W. W. Fowler's monograph now in course of preparation, and the South American *Hesperidae* for identification by Dr. F. D. Godman. In the early part of 1905 much help was given by Mr. Holland to Miss Bellamy in her work on the Hope Library, and much time was occupied in searching for Burchell's specimens for the Professor.

Owing to the co-operation between Mr. A. H. Hamm and Mr. J. Collins a far larger amount of printing and labelling was done than in any previous year, and much was accomplished in making up the arrears of former years, as will be seen in the long list of donations towards the end of this report;—this in spite of the fact that labelling and numbering donations has not been the chief work of the year. The principal labour has been printing and writing for each individual specimen the determinations of distinguished specialists who have worked out various groups in the Collection. The largest single piece of work was placing the name upon every single Lycaenid submitted to Mr. Hamilton H. Druce; nearly equal to this was the same treatment of every single Aculeate determined by Mr. Edward Saunders, F.R.S., in the Sir Sidney Saunders Collection of Greek Hymenoptera and in the 1901 collection of Aculeata from Majorca and Spain. When necessary, the specimens in Dr. Longstaff's collections from the Oriental Region, &c. (1904) and from Algeria (1905) have been similarly labelled, and the same is true of Burchell's South American *Hesperidae*, named by Dr. F. D. Godman, F.R.S., and many outlying sets of specimens which pressure of work had caused to be too long postponed—such as the *Scolytidae* named many years ago by Mr. W. F. H. Blandford, the *Tingitidae* named by Mr. G. C. Champion, &c. Mr. Shelford's work upon the Orthoptera has also necessitated a large amount of work in mending, repinning, and labelling.

The specimens pinned and "set" in Oxford have been chiefly those of Dr. Longstaff's Algerian Collection and those collected by him, Dr. Dixey, and the Professor in South Africa. Mr. A. Cant, F.E.S., has bestowed the same patient efficient care upon the numerous specimens entrusted to him.

Mr. J. Collins has filled up and placed excellent labels on the types and co-types of the recently described insects, and has at the same time entered the data upon cards, thus forming the nucleus of a card catalogue of types in the University Collection.

Assistance in working out the material of the Department.

Commander Walker has given much kind help in many directions. He examined the vast collection of Siberian beetles collected by Herr von Rengarten, near Gorbitza in Transbaikalia, and presented by Dupre P. Lance, Esq., selected the series for the Department, and himself pinned and set large numbers of specimens; he has begun to arrange the British Coleoptera, and here too has repinned and reset hundreds of the old and delicate specimens. A well arranged, correctly named, and adequately large collection of British beetles is one of the greatest wants of the Department, and the University owes a corresponding debt to the distinguished student of insect-life who has undertaken this great task. Furthermore, Commander Walker has completed a census of the Hope Collection, the result of which will be found under a separate heading. He has also most kindly assisted the Professor on very many occasions, and has continually helped naturalists who have come to name their specimens or to study the collections.

Since the early part of the year when Dr. Dixey gave much time to the library, he has, when in Oxford, devoted a great deal of labour to the incorporation in the collection of *Picrinae* of the large accumulation of accessions. This has involved a large amount of rearrangement.

The Hope Department has also received very much generous assistance from eminent specialists in many countries.

The kindest help has been continually received from Mr. Hamilton H. Druce, F.L.S., in the determination of obscure species of *Lycaenidae* and *Hesperidae*.

The two pieces of work which have chiefly needed and received a large amount of help in many directions, have been the Burchell memoir, dealt with in the next section, and a paper, still unfinished, upon the enemies, principally the predaceous insect enemies, of insects. The following naturalists have kindly assisted in the respective groups in which they

are eminent authorities:—G. J. Arrow, F.E.S., E. E. Austen, Col. C. T. Bingham, F.Z.S., Sen. Don Ignacio Bolivar, C. A. Briggs, F.E.S., G. C. Champion, F.Z.S., J. E. Collin, F.E.S., W. L. Distant, F.E.S., Sir George F. Hampson, B.A., F.Z.S., W. F. Kirby, F.L.S., W. J. Lucas, B.A., F.E.S., Claude Morley, F.E.S., K. J. Morton, F.E.S., Rev. F. D. Morice, M.A., F.E.S., R. I. Pocock, F.Z.S., Edward Saunders, F.R.S., R. South, F.E.S., G. H. Verrall, F.E.S., Col. J. W. Yerbury, F.L S.

Editing W. J. Burchell's Notes for publication and working out the corresponding parts of his Collection.

After the long list of distinguished specialists whose help was gratefully acknowledged in the Report published last year, it might have been anticipated that all the species of this collection were determined or described. This was however by no means the case, and it is now a pleasant duty to express a deep sense of gratitude to the following eminent naturalists who, in 1905, have so kindly assisted in the production of this work.

COLEOPTERA.

Carabidae. PORTUGUESE,—Dr. L. Ganglbauer, of Vienna.

Elateridae. Monsieur Ed. Fleutiaux, of Nogent-sur-Marne.

HETEROMERA.
Bruchidae.
Curculionidae. } OBSCURE AFRICAN FORMS,—Prof. C. Aurivillius, of Stockholm.

Bruchidae, and other obscure Coleoptera (mostly fragmentary). AFRICAN,—Monsieur Maurice Pic, of Digoin, Saône-et-Loire.

Staphylinidae. BRAZILIAN,—Monsieur A. Fauvel, of Caen.

ORTHOPTERA.

Blattidae. R. Shelford, M.A.

LEPIDOPTERA HETEROCERA.

Limacodidae, &c. BRAZILIAN,—Dr. Harrison G. Dyar, of Washington.

Psychidae. AFRICAN,—Dr. F. J. M. Haylaerts, of Breda.

NEUROPTERA.

Ephemeridae. BRAZILIAN,—Rev. A. E. Eaton.

Phryganidae,—Dr. Georg Ulmer, of Hamburg.

HYMENOPTERA.

DIPLOTERA. Dr. A. V. Rechberg-Schindler, of Zurich. A new African species of the genus *Odyncrus* was described by M. le Comte du Buysson, of Paris.

FOSSORES,—Dr. F. F. Kohl, of Vienna.

PARASITICA,—Dr. Gy. Szépligeti, of Budapest.

DIPTERA.

Psychodidae. BRAZILIAN,—Rev. A. E. Eaton.

Hippoboscidae. AFRICAN,—Dr. P. Speise, of Bishofsburg.

SIPHONAPTERA.

Hon. N. C. Rothschild, of Tring.

ARACHNIDA.

ACARINA. BRAZILIAN,—A. D. Michael, F.L.S.

Ixodidae. BRAZILIAN,—Professor T. Neumann, of Toulouse.

During the first half of 1905 all available time was spent upon the Burchell manuscript and Collections. In June the index of the Brazilian part was finished—a most laborious and complicated piece of work, in the details of which the kindest help and advice was received from Dr. J. A. H. Murray, M.A., LL.D., Balliol College, and Dr. W. E. Hoyle, D.Sc., M.A.,

Christ Church. The African manuscript was taken to South Africa, and on the voyage out the index of this part was most kindly made by Dr. G. B. Longstaff, D.M., New College, and Dr. F. A. Dixey, D.M., Wadham College.

A lecture on Burchell's African Travels and Discoveries (1810–15) was delivered by the Professor at Cape Town on the evening of August 17. In the course of it the lecturer spoke of the unfortunate loss of the journals in which Burchell recorded a general account of his doings during the five years in Southern Africa and the five (1825–30) in Brazil. Burchell's classical work, "Travels in the Interior of Southern Africa," does indeed give a complete record between November 26, 1810, and August 3, 1812—the day on which he brought to a conclusion his first visit to Litakun, the capital of the Bachapins, in what is now British Bechuanaland. Mr. Mason, M.A., Merton College, Head Master of the Boys' High School at Rondebosch, near Cape Town, who was present at the lecture, told the Professor that a former pupil of his, named Burchell, had brought to school a diary written by an ancestor in St. Helena. Through Mr. Mason's kind help the Professor was put into communication with Mr. Francis A. Burchell, a grand-nephew of the great explorer, who searched, and ultimately found and most kindly lent a portion of the original African Journal written by W. J. Burchell in his ox-wagon. The manuscript, covering the period between May 24 and September 2, 1812, both days inclusive, occupies the whole of a small note-book bound in sheep-skin, and still in the most beautiful condition.

At the place where Burchell's second volume comes to an end, the words "end of the 2nd volume" are written in pencil in the margin. Beyond this point one month of the lost records are here restored to us, from August 3 to September 2, 1812. Furthermore, even in the period covered by the published work there are many statements of the deepest interest to us which Burchell withheld. For the first time we are made acquainted with the day and month of his birth. It is believed—but there is no certainty—that he was born in

the year 1782. July 23, 1812, was a day of great anxiety and trouble to the explorer. Among his attendants was a man named Cornelis, of Dutch and Hottentot parentage. Cornelis had been unsatisfactory and useless from the day of his engagement when he presented himself "in a state of complete intoxication"; and on this day in the midst of the Bachapin capital, Litakun, then visited for the first time by a European, he broke into open rebellion, and Burchell was compelled, buckling on his pistols and cutlass, personally to enforce obedience. The published account ends with the words:—"Thus ended one of the most turbulent days which I had experienced since the commencement of my journey." ("Travels," vol. ii, London, 1824, p. 462.) The manuscript journal, however, concludes the day with the following personal details omitted from the second volume:—"I continued in the waggon all the evening, and to divert my mind from the past, I spent the remaining time with my flute."

"It thus has unfortunately happened that I have been prevented joining my family in their remembrances of me on this day: and that my birthday should be marked as one of the most turbulent days I have passed since landing on Africa. From the little dependence I can place on my own people my situation now begins to grow critical, and calls for the most resolute but prudent measures."

Another record of great interest is found under the date May 29, 1812, when Burchell was at Klaarwater (Griquatown) making arrangements for his journey to Litakun. It is contained in these words:—"The Sphinx Atropos is called by Colonists the *Bye-mot* or *Duyvel-bye*, and is firmly believed to be poisonous."

This sentence appears to have been written later than the brief record of the day, the writing being in a darker ink and compressed into the narrow space between the entries for May 29 and 30.

The observation by Mr. Roland Trimen, Hon. M.A., F.R.S., that the "Death's Head Moth" is an object of superstitious dread in South Africa is thus both confirmed and carried

back to a much earlier date[1]. (Trans. Ent. Soc. Lond. 1902, p. 402.)

A large number of Burchell's original drawings, Brazilian as well as African, and a small amount of manuscript are in the possession of the Rev. Evan Davies of Springs, who most kindly showed the whole to the Professor and gave him the fullest opportunity of studying them.

On returning from South Africa in October the pressure of accumulated arrears has made it impossible up to the present to undertake the small amount of work still necessary before the publication of Burchell's notes can be begun. The discoveries of Mr. Francis A. Burchell have also encouraged the hope that the missing part (March 18, 1829—Feb. 10, 1830) of the Brazilian notes upon insects may yet be recovered. Should this hope happily be realized, a little delay in the date of publication would be amply repaid by the appearance of a complete instead of an imperfect work.

Visits of Naturalists.

The usual visit of the Council of the Entomological Society of London was regretfully abandoned in 1905, owing to the pressure of preparations for the visit to S. Africa with the British Association.

The Department has been visited in the course of the year by several naturalists, who have generously contributed to its collections, or have kindly helped in naming and arranging its material. Mr. W. J. Lucas, who has named and arranged the British Odonata ("Dragon-flies"); Mr. J. Hartley Durrant, who has assisted in the determination of obscure species of Micro-Lepidoptera; Canon W. W. Fowler, D.Sc., M.A., Jesus College, who has arranged the *Membracidae* (Homoptera), and is now working at the Oriental *Cicindelidae* ("Tiger-beetles"); Mr. S. L. Hinde, who with Mrs. Hinde has presented such interesting material from British East Africa; Mr. Robert T. Turley,

[1] This brief account of the recovered manuscript is modified from a statement prepared for the "Proceedings of the Entomological Society of London," for the date on which the Journal was exhibited (March 7, 1906).

who has presented valuable material from Japan and Manchuria; Mr. H. A. Byatt, B.A., Lincoln College, who has given large collections from British Central Africa, and more recently from the neighbourhood of Berbera; Rev. J. U. Yonge, M.A., Keble College, who has recently sent specimens from Madagascar; Rev. A. E. Eaton, who has given assistance with obscure species of Diptera and Neuroptera; Mr. G. C. Champion, who has helped to name European species of Coleoptera, and presented insects from the same sub-region; Rev. H. S. Gorham, who has often given assistance with the Clerid and Coccinellid beetles; Rev. G. A. Crawshay, who has presented interesting British Coleoptera; Dr. Harrison G. Dyar of Washington, who has helped in the determination and description of certain difficult groups of moths.

The Department has also been visited by Professor W. J. Holland, Director of the Carnegie Institute, Pittsburg, U.S.A.; President David Starr Jordan and Professor Vernon L. Kellogg of the Leland Stanford University, California; Dr. T. D. A. Cockerell, of the University of Colorado; Mr. H. Rowland-Brown, Secretary of the Entomological Society of London; Dr. W. E. Hoyle, Curator of the Manchester Museum, Owens College; Rev. C. T. Cruttwell; Professor P. A. Geddes, of Edinburgh.

The number of specimens in various groups existing in the Hope Collection.

In preparation for the Report published last year, Commander Walker very kindly devoted a great deal of time to the construction of a Catalogue of the Lepidoptera and Coleoptera in the University Collections. The numbers were 112,149 Lepidoptera and 194,434 Coleoptera, the grand total being 306,583 specimens. The same kind friend of the Department has now prepared the list of the remaining Orders, which is printed below. The figures are only analysed in the case of the Orthoptera, the University Collection of this Group being of especial importance.

1. STREPSIPTERA.

British 88 and 184 Stylopised Hymenoptera, 272 }
Exotic 181 „ 216 „ „ „ 397 } 669

2. DIPTERA.

British 3441 }
Exotic 13274 } 16715

3. HYMENOPTERA.

British 9596 }
Exotic 51208 } 60804

4. HEMIPTERA.

British 2620 }
Exotic 18245 } 20865

5. HOMOPTERA.

British 2100 }
Exotic 9402 } 11502

6. ODONATA.

British 361 }
Exotic 1765 } 2126

7. NEUROPTERA.

British 729 }
Exotic 2327 } 3056

8. ANOPLURA (including MALLOPHAGA) . . 3375

9. ORTHOPTERA 14933

Analysis of the constituent Families :—

	General.	Miers.	Saunders.	Supplementary.	British.	Totals.
Forficulidae	673	42	181	7	106	1009
Hemimeridae						
Blattidae	1272		468	17	85	1842
Mantidae	1250			609		1859
Phasmidae	695		407	118		1220
Acridiidae	2918	551	1372	779	177	5797
Locustidae	817		758	417	118	2110
Gryllidae	844		165	44	43	1096
Totals	8469	593	3351	1991	529	14933

10. VARIETIES AND MONSTROSITIES 30

Grand Total . 134075

Adding this to the total number of Lepidoptera and Coleoptera, we find that the number of specimens at present incorporated in the University Collections amounts to 440,658. There are, however, specimens which have not been included, in collections which are being studied away from Oxford, a large part of the Burchell Collection which has now been separated, Collections presented but not incorporated, Collections illustrating mimicry and other bionomic problems. Taking all these into consideration, the number of insects in the Department is certainly over 450,000, and probably not less than 500,000.

In the case of the *Blattidae* all the outstanding specimens, except those in a part of the Burchell Collection, have been brought together, and as a result the Collection contains nearly 2500 specimens instead of 1842, as shown in the above table. So large an increase is not to be expected in many groups, but there are numbers of outstanding specimens to be added to all.

Work published in 1905.

The following short papers by workers in the Hope Department, or upon its material, have appeared in the Proceedings of the Entomological Society of London during the year 1905:—

Dr. F. A. Dixey, "On hybrid Saturnias," March 1, 1905; "On Natal butterflies, experimented upon by Mr. G.A.K. Marshall," March 15; "On the social web and pupal shells of *Eucheira socialis*," April 5; "On forms in the genus *Gonepteryx*," June 7; "On the scents of African Pierine butterflies," Nov. 1; "On seasonal forms of African *Pierinae*," Nov. 15; further observations on this latter subject, Dec. 6.

Dr. G. B. Longstaff communicated a note on "Heliotropism in *Pararge* and *Pyrameis*," May 3; "On scents in the male of *Gonepteryx*," June 7.

A communication from Mr. S. A. Neave, B.A., F.E.S., Magdalen College, gave interesting evidence of the superstitious dread of caterpillars with eye-like markings, April 5.

Commander Walker exhibited and contributed a note "On the type of *Dinoderus ocellaris*, Steph.," in the University Collection, May 3.

Mr. R. Shelford read notes "On a wood burrowing Lygaeid bug, and on remarkable Bornean beetles," Oct. 18; "On the larvae of *Collyris* and of *Mormolyce*," Dec. 6.

Mr. A. H. Hamm communicated a note "On the choice by *Pieris rapae* of surfaces for resting upon," Dec. 6.

The Professor read a note "Upon the 'windows' in the wings of *Kallima*," and exhibited the probable models—leaves with round holes—kindly sent to him by Mr. W. B. Grove, June 7.

The Transactions of the same Society for 1905 contain Dr. G. B. Longstaff's "Notes on the Butterflies observed in a tour through India and Ceylon," p. 61; and Mr. H. A. Byatt's "*Pseudacraea poggei* and *Limnas chrysippus*; the numerical proportion of mimic to model," p. 263. The description of the male of a new species of Lycaenid from a specimen in the University Collection (the female being in the author's collection), by Mr. Hamilton H. Druce, is published on p. 255. The specimen in question had been captured by Rev. K. St. Aubyn Rogers, M.A., Wadham College, at Rabai, near Mombasa.

Additions to the Collections in 1899.

Thirteen *Blattidae* from the neighbourhood of Kuching, Borneo (chiefly captured in 1899), presented by R. Shelford, Esq., M.A., F.L.S.

Eighteen butterflies, 1 moth, and 2 Coleoptera from the Eastern United States (probably Dublin, N.H.) were presented by Abbott H. Thayer, Esq., in addition to 45 specimens, almost exclusively butterflies, in a less perfect condition or with less complete data. All were captured in 1899. The catalogued series includes 3 examples of the Danaine butterfly *Anosia archippus* and 2 of its Nymphaline mimic *Limenitis* (*Basilarchia*) *misippus*, captured together (Aug. 12, 1899).

Additions to the Collections in 1900.

One hundred and two *Blattidae* and 196 *Asilidae* (Diptera) from the neighbourhood of Kuching (chiefly captured in 1900) were presented by R. Shelford, Esq., M.A.

An interesting specimen of *Pyrameis atalanta* (the "Red Admiral"), with an unusually large white spot in the red band of the fore wing, was presented by the captor, Giles Dixey. From Totland Bay, Isle of Wight, July 30, 1900.

Sixty-eight *Blattidae* from the De Bormans Collection of Orthoptera, purchased in 1900, were catalogued and added to the large University collection of the group.

Additions to the Collections in 1901.

The large collection of Majorcan and Spanish insects captured and presented in 1901 by the Professor, Mr. W. Holland, and Mr. A. H. Hamm, although "set" and labelled, had not hitherto been catalogued and incorporated. It was considered expedient to keep the various groups together until they were worked out. Now, however, the Hymenoptera Aculeata have been named, and the new species described by Mr. Edward Saunders, F.R.S. (Trans. Ent. Soc. Lond., 1904, pp. 591–665), and the material has accordingly been incorporated. It consists of 700 Majorcan and 585 Spanish Aculeates, including the types of the five new species (from Majorca) mentioned in last year's Report. All these 1,285 specimens are labelled with Mr. Saunders' determinations.

In addition to this important accession to the systematic collection of Hymenoptera Aculeata, 20 dark, yellow-banded Aculeates captured by the Professor, June 30, 1901, on the Pass of Soller, Majorca, have been added to the Bionomic series, together with one of the Hymenoptera Parasitica (*Leucospis dorsigera*, ♂) and 7 mimetic Diptera, all taken at the same time and place. This little collection of widely separated superficially similar forms is a beautiful illustration of synaposematic and perhaps also pseudaposematic resemblance.

Another little set of 20 black-bodied insects, with a broad red band across the abdomen, affords an even more striking proof that the members of such mimetic groups exist intermingled; for the whole of them were captured (July 15, 1901) by the Professor in a single sweep of the net, near the summit of Montserrat, near Barcelona. Nineteen of the specimens were found by Mr. Saunders to belong to five superficially similar species of the genus *Sphecodes* (*S. fuscipennis* 1, *S. gibbus* 3, *S. subquadratus* 7, *S. reticulatus* 7, *S. rufiventris* 1). The twentieth member of the group was a beautifully mimetic fly, *Ocyptera brevicornis*. All these little bees were males and therefore stingless, a fact which suggests that the Aculeata possess some other defence in addition to that from which their name is derived (Trans. Ent. Soc. Lond., 1904, pp. 644–649).

Other specimens added to the Bionomic series were Majorcan examples of Fossorial wasps and their prey:—viz. two examples of *Philanthus triangulum* together with the honey-bees which they were carrying off to their nests as food for their larvae, and one of *Pompilus viaticus* together with the spider it was dragging along.

Other smaller groups in addition to the Hymenoptera Aculeata have also been worked out, catalogued, and incorporated: viz. 11 Majorcan *Chrysididae* (Hymenoptera), named by Rev. F. D. Morice, M.A., Queen's College; 12 Majorcan and 29 Spanish *Asilidae* (Diptera), named and incorporated in the collection by Col. J. W. Yerbury; 18 Majorcan *Blattidae* and 1 from Spain, named and incorporated by Mr. R. Shelford, M.A.

Further contributions to the bionomic series have also been catalogued and incorporated. They include the following examples of insects and their enemies, captured in Spain and Majorca in 1901. The Reduviid bug, *Harpactor iracundus*, devouring the bee *Halictus scabiosae* (near Soller, Majorca, July 4), captured and presented by the Professor; the same species devouring the 'hair-streak' butterfly *Thecla ilicis* (Montserrat, near Barcelona, July 14)—Mr. W. Holland:

Harpactor sp. with a Longicorn beetle (Montserrat, July 15)—the Professor: the Asilid fly *Dasypogon diadema*, ♀, eating the wasp *Polistes gallica* ☿ (Port Bou, E. Pyrenees, June 24)—the Professor: other examples were seen on the same occasion by the Professor and Mr. A. H. Hamm, and the prey, *Polistes gallica* ☿, obtained for the bionomic series, in two cases; the Asilid *Eutolmus* ? *apicatus* ♂ and ♀ *in coitu*, the latter carrying a fly of the genus *Mydaea* (Montserrat, July 15)—the Professor: 2 *Machimus* sp., each carrying the grasshopper *Podisma frigida* (Cerbere, E. Pyrenees, July 17)—the Professor: the bee *Sphecodes reticulatus* ♂, eaten by a spider (Montserrat, July 15)—Mr. W. Holland.

Forty-one butterflies (11 catalogued) from various Indian localities, principally in Mysore, were presented by the British Museum of Natural History. The specimens, taken 1888–1899, formed part of the E. Y. Watson collection.

A small collection, of which 46 specimens have been catalogued, was purchased from Mr. J. Osborne. The insects are of various orders, chiefly from British localities. Several uncatalogued specimens have been provisionally incorporated.

Additions to the Collections in 1902.

A valuable set of 244 insects—Orthoptera and a few Coleoptera—were presented by Señor Don Ignacio Bolivar of Madrid. The value of the donation is greatly increased by the fact that all the species have been named by this eminent authority. The great majority of the specimens are Iberian, but a few are Asiatic, and a few W. African.

A fine collection of 556 Diptera, including 128 *Asilidae*, was presented by Guy A. K. Marshall, Esq., F.Z.S. Nearly the whole of the specimens were captured, in the Salisbury district of Rhodesia, in 1899. The *Asilidae* have now been kindly studied and incorporated in the collection of that group by Col. J. W. Yerbury. A fly attacked by an ant and a Neuropterous insect were also presented by Mr. Marshall.

One hundred and seventy-nine butterflies, of which 75 have been catalogued, together with a *Mantis* and several ants,

were presented by C. A. Wiggins, Esq., a part of the splendid collection given by him in 1902 and 1903. These specimens were from Kilindini, on the island of Mombasa (60 ft.), and from Changamwe (500 ft.), on the Uganda Railway, 10 miles west of Mombasa. All were collected in 1901. Forms such as these, characteristic of the Eastern tropical coast-belt of Africa, afford a most interesting comparison with the allied species or varieties from the shores of the Victoria Nyanza (see donations in 1903).

Fifteen butterflies from various European localities were presented by Herbert Druce, Esq., F.L.S., F.Z.S.

Additions to the Collections in 1903.

The *Blattidae* of the fine general collection of Orthoptera, presented by Malcolm Burr, Esq., B.A., F.L.S., F.Z.S., New College, have now been labelled, catalogued and incorporated. They amount to 243 specimens. Large numbers of the species are named, some of them by Dr. Brunner von Wattenwyl, of Vienna, the most distinguished authority on the Orthoptera.

The remaining specimens of the remarkably fine collection of butterflies from British East Africa, presented in 1903 by C. A. Wiggins, Esq., have now been catalogued and incorporated. 2,568 specimens, of which 1,421 were catalogued as permanent accessions, were acknowledged in last year's Report. These catalogued specimens were collected at the following localities, near the shores of Lake Victoria Nyanza: 1. Tiriki (404 specimens), 2. Nyangori (461), 3. Ugaia (285), 4. Entebbe (271). The specimens now gratefully acknowledged come from the localities numbered below 5–9. The types, the specimens illustrating mimicry, and nearly the whole of the *Lycaenidae*, *Hesperidae* and moths are excluded from the captures recorded under localities 5–9. The specimens in each of these categories are treated as a whole and acknowledged separately. It must also be remembered that the numbers quoted below do not include the specimens still in "papers." All these have been carefully studied, and are

recorded in Mr. S. A. Neave's paper; but it has not been necessary to "set" them for the University Collection.

5. Kisumu, north-east shore of the Victoria Nyanza, 3,770 ft., nine miles south of the Equator, in the neighbourhood of the terminus of the Uganda line at Port Florence. Plain and woodland. The collection from this locality, made at various dates in 1903, included 680 specimens, of which almost exactly half, 343, have been catalogued. In addition to these, about 300 examples of *Limnas chrysippus*, and its chief mimic, *Hypolimnas misippus* ♀, although uncatalogued, will be largely drawn upon for the collection illustrating mimicry. The proportion between the individuals of model and mimic is finely shown by large captures of both made on several days, and carefully labelled.

6. Kalachonyo, a low plain, twenty miles south of Kisumu. 3,800 ft. The collection, made between December 19 and 27, 1902, contained 124 specimens, of which 75 (including 2 moths) have been catalogued. The locality was especially rich in Pierine butterflies—73 specimens, of which 52 have been catalogued.

7. Usemi, an open plain, ten to fifteen miles west of Kisumu, nine miles south of the Equator. 3,800 ft. The collection, made between May 1 and 7, 1903, contained 53 specimens, of which 12 (including 3 moths) have been catalogued.

8. Kakamega's, near Mumias, on the Uganda railway, about fifteen miles north-east of Kisumu. 5,500 ft. Nine butterflies, of which 6 are catalogued, were collected in this locality in 1902.

9. Unyamwezi, Mwanza, German East Africa. The collection, made by natives in August, 1902, contained 71 specimens, of which 23 are catalogued.

In addition to the above, a little collection from Nyangori, made by natives, July 6–13, 1903, contained 32 specimens (including 1 Dipterous insect), of which 15 have been catalogued. The latter includes the beautiful *Planemoides*-form of female *Papilio dardanus*, mimetic of *Planema poggei*.

Of the groups which have been catalogued separately, the *Lycaenidae* ("Blues") include 249 specimens, in addition to

nearly 300 uncatalogued, but in many cases provisionally included; the *Hesperidae* ("Skippers") 74, in addition to 120; the Lepidoptera Heterocera (moths) 27, in addition to 32. The 40 specimens constituting the majority of the types and co-types of the new species described by Mr. S. A. Neave, B.A., Magdalen College (Nov. Zool., vol. xi, 1904, p. 337), have also been catalogued separately. It must be remembered however that these are by no means all; for a considerable number were catalogued under the year 1902, and acknowledged in the Report of last year. Finally, 63 specimens have been catalogued separately, as part of a specially interesting series illustrating and illuminating the problems of mimicry. Inasmuch as this series will form the chief part of the material of a memoir to be published shortly by Mr. S. A. Neave, it is unnecessary to describe it further on the present occasion.

Two fine Coleoptera and 2 Hymenoptera Aculeata were presented by Dr. Richard Evans, D.Sc., M.A., Jesus College, together with a few uncatalogued insects. All were from British Guiana (1901–1903).

Additions to the Collections in 1904.

The fine collection of insects captured and presented by Dr. G. B. Longstaff, D.M., New College, includes the material of his memoir in Trans. Ent. Soc. Lond., 1905, pp. 61–144. All are now labelled, and the permanent accessions catalogued. A large proportion of the whole has been incorporated in the University collection by Dr. Longstaff himself, who has come to Oxford on several occasions for this purpose. The specimens from many localities in India and Ceylon belong to the most varied groups, and number 1,494, of which 672 have been catalogued. This latter number by no means represents the accessions; for large numbers of uncatalogued specimens have been or will be incorporated, at any rate provisionally.

A small but valuable set of 177 specimens, of which 110 have been catalogued, was collected at Singapore and in S.E. China.

Another set of 221 specimens, of which 157 have been catalogued, was collected in Japan. Specimens from this part of the world are very imperfectly represented in the University Collection, and the accession is correspondingly valuable.

Seventy specimens, of which 44 have been catalogued, from Canada.

The whole of the specimens of Dr. Longstaff's donation, amounting to nearly two thousand, bear full and accurate data, rendering the examples even of common species particularly valuable. Large numbers of older specimens with insufficient data have now been replaced by Dr. Longstaff's captures.

In addition to the above a fine example of *Trogonoptera brookeana*, collected Jan. 1, 1904, by W. G. Freedley, Esq., at Buso, near Kuching, Borneo, was presented by Dr. G. B. Longstaff.

Thirty-five Diptera, of which 32 have been catalogued, were presented by Col. J. W. Yerbury. The captures were made in many widely scattered localities, and range over several years.

A co-type of the fly *Saundersia rufopilosa*, v. d. Wulp, from Irazu, Mexico (6–7,000 ft.) was presented by the British Museum of Natural History.

The following valuable addition to the bionomic collection was made by R. Shelford, Esq., M.A., the generous donor to whom the University owes nearly the whole of the large bionomic series from Borneo:—

Five members of the dominant group of small black-and-white insects mimicking the little stingless bees of the genus *Melipona*. In addition to one of the models, this group comprises two other Hymenoptera—a Braconid and a Chalcidid, a Reduviid (Hemiptera) and an Asilid fly.

A Lycid beetle with two other beetles mimicking it.

An example of a slender Longicorn beetle of the genus *Oberea* (near *O. strigosa*) mimicking a Braconid (Hymenoptera).

A set of twelve beetles with similar warning (synaposematic) colours—blue posteriorly, red or yellowish anteriorly.

An example of *Stegenus dactylon*, a Longicorn beetle mimicking a Brenthid.

A *Mantispa* (Neuroptera) and its Aculeate (Hymenoptera) model, taken on the same flower-head.

An *Icaria* (Hymenoptera Aculeata) with a peculiar fibrous growth upon it, probably fungoid in nature. The fibres did not interfere with flight, for the insect was captured upon the wing by Mr. Shelford.

In addition to the above, 6 examples of 4 species, compared with Cameron types, of Sarawak *Ichneumonidae*, were presented by R. Shelford, Esq., together with an interesting Stratiomyid fly and a set of 41 Brenthid beetles, named by Dr. A. Senna, of Florence.

The valuable Bornean specimens, referred to above, were collected at various dates in the State of Sarawak, and, as regards the great majority, in the neighbourhood of Kuching.

Six *Lycaenidae* and *Hesperidae* from British East Africa, presented by the Rev. K. St. Aubyn Rogers, M.A., Wadham College, were not incorporated with the valuable set acknowledged in the Report for 1904, inasmuch as they were then being studied by Hamilton H. Druce, Esq., F.L.S. One of the Lycaenids has been described by this authority as *Spindasis kallimon*. The Hope specimen is the male type of the species.

Four Bosnian butterflies, Sept. 10, 1901, were presented by the captor, F. Merrifield, Esq., Pres. E. S.

Eighteen moths and 3 butterflies from Fort Hall in the Kenya Province of British East Africa (1903–4) were presented by the captors, S. L. Hinde, Esq., and Mrs. Hinde. Several specimens were bred from larvae, and are accompanied by a record of the dates of the various transformations, and beautiful drawings of the early stages by Mrs. Hinde.

A small collection of 28 insects (Lepidoptera, Hymenoptera, and Neuroptera) from Malta, June, 1904, was presented by the captor, N. Annandale, Esq., B.A., Balliol College, Superintendent of the Indian Museum, Calcutta. A moth

from Suez (July 1 1904) was also presented by the same donor, together with 64 insects of various Orders and an Isopod Crustacean from the Faroe Islands. This latter collection, which is of special interest, was made in August, 1903 (Ent. Month. Mag., 1903, p. 249).

Seventy-seven Neuroptera and Orthoptera from various localities and captured at various dates were presented by W. J. Lucas, Esq., B.A. The majority of the specimens belong to the Odonata ("Dragon-flies"), and include specimens from France, New Guinea, New Zealand, Persia, Canada (30 specimens collected by H. S. Fremlin, Esq.), Western United States (5, collected by W. Mansbridge, Esq.), Florida (7, and one *Ascalaphus*), Ceylon (10), Sumatra (6). Other interesting Neuroptera are a species of *Nemoptera* (probably from Syria), and a Myrmeleonid from Cape Colony. The Orthoptera include a fine Forficulid ("Earwig") from W. Africa. In addition to the above a fine Tipulid (Diptera), captured (1900) at Meiringen, by H. Main, Esq., was presented by the same kind friend of the Department.

One hundred and thirty-five insects of various Orders from the Transvaal (1902–1904) were presented by the captor, Trooper E. E. Hamm. The University is indebted to the kindness of Mr. A. H. Hamm, of the Hope Department, through whom this welcome and interesting donation has been made. Eighty-five specimens have been catalogued as permanent accessions, while many of the others will be provisionally included in the collections. The insects were chiefly taken at Potchefstroom, but specimens from Balmoral, Klerksdorp, and Krugersdorp are also present. Although S. African insects are such a prominent feature of the University Collection, specimens from the Transvaal are very poorly represented, and this little collection is correspondingly valuable. Nearly all the Orders are represented by a few specimens: the moths by 53, the Orthoptera by 19, the Coleoptera by 20. The 10 Neuroptera all belong to the *Myrmeleonidae*, and include examples of two very fine species, one of which is entirely new to the Collection and a most remarkable form.

Additions to the British Collections in 1904.

A male and female of the Geometrid moth, *Amphidasis betularia,* captured *in coitu*, at Weston-super-Mare, July 10, 1904, were presented by Dr. W. H. Jackson, D.Sc., M.A., Keble College. The female is of the type form, while the male is a black variety approaching *doubledayaria.* Dr. Jackson also presented 7 insects captured, July 14, 1904, upon the flowers of *Oenothera lamarckiana*, in the same locality.

A specimen of the common Noctuid moth, *Phlogophora meticulosa,* captured, Nov. 11, 1904, at Paddington Station, was presented by the Professor.

Three examples of British butterflies injured apparently by the attacks of enemies, (Huntingfield, near Faversham, Kent, Sept. 1903 and 1904) were presented by the captor, A. J. Chitty, Esq., M.A., Balliol College. Another interesting addition to the bionomic series is the head of a *Bombus* found, May 1903, on the top of a gate-post near the same locality. When found by Mr. Chitty the jaws were still opening and shutting. It is evident that the head was all that remained of a humble-bee recently devoured, probably by a bird.

The following rare or extremely local insects were also presented by the captor, A. J. Chitty, Esq.:—*Hydroporus bilineatus,* March, 1891, Deal, new to the British list: the "earwig," *Apterygida media,* Sept., 1894, Huntingfield (in hop-field); recorded in Ent. Month. Mag., 1904, p. 261: two examples of the beetle *Anthribus albinus*, Sept., 1902, Huntingfield (in old hedge): the beetle, *Bembidium virens*, probably captured at Beauley, Inverness, in Sept., 1893.

A specimen of the moth, *Cerura vinula*, emerged Oct. 28, 1905, from a larva found July 20, 1904, at Oxford, and presented by Mr. J. Mogridge. The unusually late emergence is interesting.

Twenty-nine insects of various groups from the neighbourhood of Oxford (1904) were presented by the captor, Commander J. J. Walker, Hon. M.A. The most interesting were

a series of the injurious beetle, *Podagrica fuscicornis*, on *Malvaceae*, in Gee's Nursery Gardens, June 26 (recorded in Ent. Month. Mag., 1904, p. 183): a series of the beetle, *Plagiodera versicolora*, S. Hincksey, July 23 (l. c., 1904, p. 210): 2 specimens of the "earwig," *Forficula lesnei*, Beckley, Sept. 10: an example of the local aquatic Hemipteron, *Ranatra linearis*, Tubney Wood, Sept. 17.

From other British localities the following rare or local insects were presented by Commander Walker: the Curculionid beetle ("weevil"), *Bagöus brevis*, Woking, May, 1904: 3 examples of the Homopteron, *Asiraca clavicornis*, near Stroud, Kent, July, 1899: 4 specimens of the Geometrid moth ("pug"), *Eupithecia extensaria*, bred, near King's Lynn, June, 1903, by E. A. Atmore, Esq., F.E.S.

Seven males and twelve females of the Geometrid moth, *Nyssia lapponaria*, were bred in the Department (March–May, 1905), from ova, laid April, 1904, presented by E. A. Cockayne, Esq., B.A., Balliol College. The parent moth was obtained by the donor at Rannoch, Perthshire.

One hundred and sixty-five insects of several Orders captured at various dates in many British localities were presented by W. J. Lucas, Esq., B.A. All the specimens bear excellent data, and the whole forms a valuable accession to the British collections. In addition to the above, the same kind donor presented a Syrphid fly, bred, Sept., 1903, by G. T. Lyle, Esq., from a larva found feeding on that of the Geometrid moth *Eucosmia undulata*, at Brockenhurst; also 3 insects captured, August, 1903, in the Isle of Man, by T. H. Shepherd, Esq.

Additions to the Collections in 1905.

A fine set of 594 butterflies, from the neighbourhood of Macao, S.E. China (1902–1905), presented by J. C. Kershaw, Esq., of Macao, have received their printed labels, and as regards the great majority have been incorporated in the collection. Of this important set 234 specimens have been catalogued as permanent accessions. One Lycaenid and 11 Hesperid butterflies from Hong Kong (1901), were presented by

the same naturalist. All have been incorporated, and 6 catalogued as permanent accessions.

The fine Asilids, *Microstylum spectrum*, Wied. (one), and a large species of *Promachus* (3 specimens), from Macao, were presented by J. C. Kershaw, Esq., together with the prey with which they were captured on July 18, 1905, viz., a *Cicada*, and 2 specimens of the fierce wasp *Vespa cincta*, var. It was unfortunately impossible to assign the individuals to their particular captors; but the whole set of specimens illustrates in a striking manner the remarkable powers of these predaceous flies.

Two hundred and eighty butterflies, of which 161 have been catalogued, from the neighbourhood of Courmayeur (June, July, 1904), were presented by the captor, Sir George F. Hampson, Bart.

Twenty-five *Blattidae* from various localities in Sarawak, Borneo, were presented by J. Hewitt, Esq., Curator of the Sarawak Museum, Kuching, together with 3 *Mantidae* (the latter uncatalogued).

Seven insects of various groups from Sarawak, and 33 *Culicidae* from the neighbourhood of Kuching, the Capital of this State, were presented by H.H. the Rajah of Sarawak.

The following fine and varied collections of insects were presented by R. Shelford, Esq., M.A. :—

Sixteen Coleoptera from Kuching. Five out of the ten catalogued specimens are *Histeridae*, named by G. Lewis, Esq. From Buntal, near the same locality 3 interesting Stratiomyid flies, bred by Mr. Shelford from larvae under bark of Mangrove (1903).

A hundred and thirty-one Lepidoptera from Java (April, 1905). Mr. Shelford was in the island at an unfortunate season, so that only 42 specimens were in a state to be catalogued. Insects from Java are particularly wanted in the Hope Collection, so that nearly the whole of Mr. Shelford's specimens have been provisionally incorporated. In addition to the Lepidoptera, 19 Neuroptera and Orthoptera were presented. All of these have been catalogued.

Twenty-one Lepidoptera from Bali, Lesser Sunda Islands (May, 1905), of which 3 are catalogued.

Six insects from Lombok, Lesser Sunda Islands (April 28, 1905), of which 3 are catalogued.

Ninety-six Lepidoptera and 3 other insects from Celebes (May, 1905), of which 42 are catalogued.

Twenty Lepidoptera from Ternate (May, 1905), of which 6 are catalogued.

Ninety-six insects of many groups from the Botanic Gardens, Singapore (Feb., March, 1905), of which 58 are catalogued. These captures were made by H. N. Ridley, Esq., M.A., Exeter College, and the donor.

Six hundred and ninety-three insects of many groups from the Malay Peninsula (Feb., March, 1905), of which 491 are catalogued. The great majority of the specimens were captured in the Larut Hills, Perak, at a height of 4,000–4,500 ft.

A specimen of the Australian Danaine butterfly *Limnas petilia*, captured (Oct. 14, 1904) at Flying Fish Cove, Christmas Island, by R. Hanitsch, Esq., was also presented by R. Shelford, Esq.

Fifteen butterflies and 1 moth from localities visited by Mr. Shelford exhibit injuries, probably due to the attacks of enemies. In all cases except five the injury was observed before the capture of the insect. All have been added to the bionomic series, together with a *Papilio* and an *Ornithoptera* in which Mr. Shelford had noted the remarkable tenacity of life so often found in specially protected forms. The observation suppots the conclusion already reached on other grounds that the *Papilioninae* are a distasteful group.

A Euploeine model and its Elymniine mimic captured on the same day in the Larut Hills, Perak, have been added to the bionomic series, together with a Dammar bee (*Melipona*) and 3 different Diptera, mimicking its simple and characteristic black and white pattern. The latter group is from Kuching, Sarawak, and from the same locality the bionomic series has been enriched by another mimetic fly (*Ceria*) and

two insects (a Heteromerous beetle and a Fulgorid), proved to be unpalatable to fowls.

A hundred and thirty Asilid flies, from India and Ceylon, of which 112 have been catalogued, were presented by Col. J. W. Yerbury. The great majority were probably captured in the neighbourhood of Poona, about the year 1888, by T. B. Fry, Esq., I.F.S.

The most important accession of the year has been, as in earlier Reports, the material of observations and experiments conducted by Guy A. K. Marshall, Esq., and generously presented by him to the University.

In 1903, 1904 and 1905, Mr. Marshall has made persistent attempts to ascertain the nature of the physiological stimulus which determines one or both of the wonderful seasonal changes of *Precis sesamus*. The material of his numerous experiments, together with 139 wild forms captured for comparison with the results of artificial conditions, includes no less than 509 specimens. The offspring belonging to twelve synepigonic families have been subjected to investigation: in 8 cases the female parent, in 2 cases both parents exist in the material, and can be compared with their offspring. This is the first occasion on which both male and female parents of this species have been thus available. Furthermore, in all previous investigations the parent has belonged to the red wet-season or summer phase, but this new material contains an example of a blue dry-season parent with 23 offspring,—16 belonging to the wet phase, 7 to the dry. It is hoped that an account of this important material will be published at no distant date.

Three captured examples of *Precis archesia*, and 24 bred from captured larvae,—in 17 cases subjected to experiment. This interesting species has never yet been bred from a parent of one seasonal phase to offspring of the other. While this still remains to be done in *P. archesia*, another species has now for the first time yielded to Mr. Marshall's efforts. I refer to *Precis ceryne*, of which a wet phase parent with its 8 dry phase offspring is now added to the Hope Collection.

This is the fourth species of *Precis* thus traced from one phase to the other by Mr. Marshall,—*Precis sesamus* in 1898, *P. antilope* in 1902, *P. actia* in 1903, and now *P. ceryne* in 1905.

In addition to the experiments upon the Nymphaline genus *Precis*, Mr. Marshall has done an immense amount of work upon seasonal forms of the *Pierinae*. This material he has generously placed at the disposal of Dr. F. A. Dixey for critical examination and publication. It consists of the following sets:—

A hundred and twenty-seven examples of *Teracolus omphale*, including offspring belonging to 9 families, the female parent present in 8 cases.

A hundred and twenty-three examples of *Teracolus achine*, including offspring belonging to 13 families, the female parent present in 12 cases.

Nine examples of *Teracolus ione*,—two female parents with 3 and 4 offspring respectively.

Eighty-nine examples of *Belenois severina*, bred from two companies of young larvae, each the offspring of a single pair of parents.

One hundred and twenty-eight *Pierinae*, captured in 1905 in the neighbourhood of Salisbury. Nearly the whole of these belong to the same species as those experimented upon, and are thus available for comparison.

In addition to the above, a set of 73 insects of many Orders from the Salisbury district include the rare Lycaenid *Mimacraea marshalli* mimetic of *Limnas chrysippus*, and several pairs of insects captured *in coitu*. Among these latter is a pair of *Mutillidae*, which, as Col. C. T. Bingham informs me, enable us to unite under a single species a male and a female hitherto considered to belong to entirely different groups of the family. This is a striking illustration of the great results which would be achieved if such specimens were collected on a large scale.

In addition to the above splendid accessions from the Salisbury district, we owe to the same generous donor the

following fine material from S.E. Rhodesia, chiefly from Chirinda Forest (3,600–4,000 ft.), Melsetter, Gazaland.

Two hundred and one Lepidoptera and 8 Hymenoptera; 119 of the former and the whole of the latter have been catalogued. Seven butterflies and one moth, injured apparently by the attacks of enemies, have been added to the bionomic series. In addition to the above, 5 butterflies captured in the same district by C. F. Swynnerton, Esq., were presented by G. A. K. Marshall, Esq., together with one interesting addition to the bionomic series.

The most conspicuous butterfly in this forest is the large black and white Danaine *Amauris niavius* (form *dominicanus*): next to this comes the much smaller Danaine *Amauris ochlea*. In mimetic, or more probably synaposematic, association with one or both of these are a number of butterflies of other families and sub-families—*Papilioninae*, *Pierinae*, *Acraeinae*, and *Nymphalinae*. A group containing eight specimens of these models and their mimics, captured on Oct. 6, 1905; a second, containing nine specimens, on Oct. 10; and a third, containing eleven, on Oct. 18, have been added to the bionomic series. The last-named group includes the larger model only.

Another abundant but, in the forest, less conspicuous model is provided by the black buff-marked white-spotted Danaines *Amauris lobengula* and *A. albomaculata*. A group containing six of these models and their mimics, captured on Oct. 7, 1905, has been incorporated.

The following models and their mimics, also captured in 1905 by Mr. G. A. K. Marshall in the same locality, have been added to the collection:—

A Syntomid moth and its Ichneumonid model: Oct. 14.

A Neuropterous mimic and 2 Hymenopterous models: Oct. 18.

A Dipterous mimic (*Stratiomyidae*) and 2 Hymenopterous models: Oct. 4.

Four Dipterous mimics, 1 Ortalid and 3 *Loxocera* (*Psilidae*), and 2 Hymenopterous models: Oct. 8.

From various localities in S.E. Rhodesia, other than Chirinda, 37 insects of various Orders taken in 1905 were presented by Mr. Marshall, together with the following interesting additions to the bionomic series:

A beautiful Dipterous mimic, *Systropus* (*Bombyliidae*), and 3 Aculeate models, all four insects captured on the same bush on Oct 26, at Mpudzi River, Manica.

A beautiful mimetic moth and its Hymenopterous (Braconid) model: Oct. 25, Mangesi River, Manica.

A much mutilated example of the highly conspicuous nauseous Acraeine, *A. anemosa*.

A Lycaenid butterfly from Stellenbosch, Cape Colony (Nov., 1904), was also presented by G. A. K. Marshall, Esq.

In addition to the above donations from the Salisbury district, there have been more recently catalogued and incorporated 3 miscellaneous insects and 2 examples of the *dorippus* (= *klugii*) form of *Limnas chrysippus*, excessively rare in South Africa, and now for the first time recorded from Rhodesia. These 2 specimens, which are unfortunately in poor condition, were captured by — Fraser, Esq., and Hermon Brown, Esq.

In addition to the donations from Mount Chirinda, Mr. Marshall has presented 15 Odonata ("dragon-flies"), and one *Ascalaphus*, all of which have been catalogued and incorporated.

Ever since the appearance, in 1902, of Mr. Guy Marshall's memoir on the bionomics of S. African insects, naturalists have most kindly aided in the growth of the bionomic collections of the Hope Department. The increase has been especially manifest in the series of insects and their enemies, so that the time has arrived when it is expedient to publish the collected results as soon as possible. In preparation for this work the whole of the material has been carefully examined so that all the specimens are now catalogued and supplied with printed labels. The following important accessions are now gratefully acknowledged:—

Asilid flies and their prey, presented by Guy A. K. Marshall, Esq., from Rhodesia:—

Eleven specimens of species of the genus *Promachus* and their prey, consisting of beetles, Termites, Hymenoptera, and Diptera, including in one case a male of the same species as the captor.

Two specimens of *Alcimus alamanus* (=*perlongus*) carrying respectively a Lycaenid butterfly and a honey-bee: one of *Laxenecera albicincta* with a Dammar-bee (*Melipona*); one of *Lophonotus* ? *ustulatus* with a Chalcidid.

Asilid flies and their prey were also presented by the following naturalists:—

Machimus ? *chrysitis*, carrying the tiger-beetle *Cicindela sylvatica*, from Puerto de Pajares, N. Spain (1904), presented by the captor, G. C. Champion, Esq.

A fine collection of Asilids and prey from Spain, presented by Dr. T. A. Chapman: *Saropogon* ? *frontalis* with Anthomyid fly, *Mydaea* sp.; *Laphria flava*, with *Formica rufa*, ♂; 2 *Machimus* ? *chrysitis*, with the bee *Andrena fuscipes* and the grasshopper *Gomphocerus sibericus*, respectively; *Epitriptus inconstans* (probably), with the Pyralid moth *Cleoleobia angustalis*; 12 *Dasypogon diadema* (3 ♂, 9 ♀), with Coleoptera, Diptera and, in 7 cases, Hymenoptera.

Dysmachus ? *spurius*, with the Geometrid moth, *Aspilates ochrearia* (=*citraria*), from Algeciras, Spain, presented by the captor, Rev. F. D. Morice, M.A., Queen's College.

Laxenecera flavibarbis carrying *Apis florea*, probably collected by T. B. Fry, Esq., at Poona, about 1888, presented by Col. J. W. Yerbury.

Damalina myops ♀ devouring *Melipona vidua* ☿ from Maymyo, Upper Burma (Sept. 5, 1898); presented by the captor, Col. C. T. Bingham. The example is all the more interesting because the predaceous fly is a beautiful mimic of the little bee upon which it was preying.

The remaining *Asilidae* with prey are British species, and all except one from British localities:—

Dioctria oelandica ♀ devouring the Ichneumonid, *Cratichneumon annulator* ♂ (Pamber Forest, near Basingstoke, May 30,

1905), captor and donor H. St. J. K. Donisthorpe, Esq., F.E.S.; *Dysmachus trigonus* ♂ with the fly, *Mydaea urbana* (Jersey, near St. Aubyn, June, 1903), Edward Saunders, Esq., F.R.S.; *Dysmachus trigonus* ♀, with the fly *Hilara* sp. ♀ (Tubney Wood, near Oxford, July 10, 1904), Mr. A. H. Hamm; *Dysmachus trigonus* ♂, with the beetle, *Onthophagus fracticorius* ♀ (Deal, Sandhills, Aug. 6, 1905), Mr. A. H Hamm; *Dysmachus trigonus* ♀, with the "grass-moth," *Crambus pratellus* (Tubney Wood, near Oxford, June 26, 1905), Mr. J. Collins; *Machimus atricapillus* ♀ with the fly *Dolichopus cingulatus* (Deal, July 9, 1904), A. J. Chitty, Esq., M.A., Balliol College; *Machimus atricapillus* ♀, with the fly *Sarcophaga melanura* (Deal, Sandhills, Aug. 6, 1905), Mr. A. H. Hamm; *Neoitamus cyanurus*, with the Hemipterous insect, *Anthocoris sylvestris* (Pamber Forest, May 30, 1903), H. St. J. K. Donisthorpe, Esq., F.E.S.; *Neoitamus cyanurus*, ♀ with the fly *Varichaeta* (*Erigone*) *nemorum* (Newland's Corner, Surrey, June 18, 1904), W. J. Lucas, Esq., B.A.; *Neoitamus cyanurus* ♀, with the fly, *Myopa buccata* ♂ (Bagley Wood, near Oxford, June 10, 1905), Mr. A. H. Hamm.

A pair of a species of *Dysmachus*, *D. trigonus* or an allied species, from the Cantabrian Range, N. Spain (July 3–21, 1904), were presented by the captor, Dr. T. A. Chapman. The insects were taken *in coitu*.

Empid flies with their prey, presented by the following naturalists:—

Hybos femoratus, with the Homopteron, *Zygina flammigera* (Torcross, S. Devon, 1903); 2 *Empis tessellata* with the Diptera, *Dryomyza anilis* and a Tipulid respectively (Nethy Bridge, Inverness, 1904); a ♂ and ♀ *Empis opaca*, *in coitu*, the ♀ carrying the fly, *Bibio lacteipennis* (Brodie, Nairnshire, 1905); 2 *Empis bilineata*, with *Bibio lacteipennis* (Golspie, Sutherland, 1904), and the Empid fly *Empis stercorea* (Nairn, 1905), respectively; 1 *Empis grisea*, ♂, with the fly, *Pegomyia bicolor*, ♂, (Golspie, 1904),—all presented by Col. J. W. Yerbury.

Five *Empis tessellata*, with the following flies, *Mydaea* sp., *Hylemyia* sp., *Dilophus febrilis*, and in 2 cases *Bibio marci* (all

from Twitchen, Mortehoe, N. Devon, May, 1905).—Dr. G. B. Longstaff, D.M., New College.

Empis tessellata ♀, with the fly *Aporomyia dubia* ♂ (Pamber Forest, near Basingstoke, May 30, 1903); *Hilara* sp., ♀, with the Dipterous insect *Chironomus riparius*, ♀ (Tewkesbury, May 19, 1904).—H. St. J. K. Donisthorpe, Esq. F.E.S.

Empis livida ♀, devouring the fly, *Borborus nigrifemoratu* (near Shotover Hill, Oxford, April 17, 1904). Mr. A. H. Hamm.

Empis livida, ♂, with the Phryganid ("Caddis-fly"), *Lype phaeopa* ♀ (probably Somerset, July, 1905). Edward Saunders, Esq., F.R.S.

Empis livida ♂, with the moth, *Tortrix viridana* (near Oxshott, Surrey, June 29, 1904). W. J. Lucas, Esq., B.A.

The following Scatophaga ("Dung-flies") devouring other Diptera were presented by Col. J. W. Yerbury:—

Scatophaga stercoraria (Porthcawl, S. Wales, June 12, 1903), eating *Macronychia viatica*, a fly new to the British list. The captor is in the Bionomic series of the Hope Department, the prey in the British Museum of Natural History. *Scatophaga suilla* with its prey the fly *Dicranomyia lutea* (Aviemore, Spey Valley, Aug. 17, 1904).

Hemiptera with their prey, presented by the following naturalists:—

Harpactor iracundus, devouring the bee *Halictus mucoreus* (La Peñalara, La Granja, Spain, July 29, 1904). Dr. T. A. Chapman.

Picromerus bidens, eating a dead caterpillar, probably of *Bombyx rubi* (New Forest, 1904). W. J. Lucas, Esq., B.A.

Larva, probably of *Podisus luridus*, with the beetle *Phyllodecta vitellina* (Battle, Sussex, Aug. 6, 1905). H. St. J. K. Donisthorpe, Esq., F.E.S.

Larva of a Capsid, with a Dipterous insect of the genus *Cricotopus*, probably *C. sordidellus* (Oxford University Parks, June 24, 1905). Mr. A. H. Hamm.

Hymenoptera, with their prey, or the prey of their larvae, were presented by the following naturalists:—

A wasp, *Vespa vulgaris* ☿, found eating the butterfly *Pararge egeria* (New Forest, Aug. 13, 1905). W. J. Lucas, Esq., B.A.

The Fossorial wasp, *Crabro cribrarius*, ♀, carrying the fly *Calliphora vomitoria* ♀ (Brodie, Nairnshire, July 18, 1904). Col. J. W. Yerbury.

A *Curculio* (" Weevil "), *Otiorrhynchus sulcatus*, found in the burrows of the Fossorial wasp, *Cerceris arenaria*; the fragments of 19 specimens (Lyme Regis, July 30, 1905). A. J. Chitty, Esq., M.A., Balliol College.

The Tenthredinid (" Saw-fly "), *Allantus arcuatus*, devouring an Acalypterate muscid,—a fragment (near Sandwich, July 18–21, 1905). H. St. J. K. Donisthorpe, Esq., F.E.S.

Odonata (" dragon-flies ") with their prey, presented by the following naturalists:—

Cordulegaster annulatus, ♀, devouring one of the common wasps, *Vespa rufa* (New Forest, Aug. 6, 1898). W. J. Lucas, Esq., B.A. The wasp was still alive, although its thorax had been crushed by the dragon-fly. *Pyrrhosoma nymphula*, with an Ephemerid, " May-fly" (Aviemore, June 5, 1904). Col. J. W. Yerbury.

Panorpidae ("Scorpion-flies") with their prey, from Tewkesbury, 1904, presented by H. St. J. K. Donisthorpe, Esq., F.E.S. *Panorpa communis*, ♂, with the beetle *Telephorus lituratus* (May 19); *Panorpa germanica*, ♂, with a Bibionid fly, probably *Dilophus febrilis* ♂.

Coleoptera with their prey:—

Gyrinus natator (the " whirligig beetle ") with the " dung-fly " *Scatophaga merdaria* (Belvedere, near Woolwich, April 2, 1905), Col. J. W. Yerbury; the Staphylinid beetle, *Ocypus olens*, with the head of its prey, a Carabid beetle, protruding from its jaws (probably from Reigate), Edward Saunders, Esq., F.R.S.

A fine specimen of the " Red Admiral " of the Canary Islands (*Pyrameis callirrhoe*, var. *vulcania*) from near Orotava, Teneriffe (400 ft.), Jan. 12, 1905, was presented by the captor, H. Richardson, Esq.

An example of the magnificent day-flying moth, *Urania rhiphaeus*, from Madagascar, was presented by Mrs. H. N. Moseley.

Only a small proportion of the specimens generously presented by Herbert Druce, Esq., F.L.S., have been catalogued and incorporated. The specimens thus dealt with include insects from the following interesting localities:—

Thirteen butterflies from Caparo, West Central Trinidad, collected 1904–5, by F. Birch; 2 fine Papilios and 2 moths from Merida, Venezuela (about 5,000 ft.), collected Oct., 1902; 10 butterflies from Carabaya and Limbani, S.E. Peru (9,500 ft. and 10,000 ft.), collected May and Nov., 1904, by G. Ockenden; 9 butterflies from Keelung, Formosa.

The following accessions from European localities are due to the kindness of the captor, Hamilton H. Druce, Esq., F.L.S.:—11 insects from Bad Nauheim (Sept. 10–15, 1905); 34 insects from various localities in the Austrian Tyrol (1904), including 4 examples of the fine *Erebia nerine*, and an *Erebia* with beautifully symmetrical injuries to the hind-wings; a Vespid from Neuhausen, Switzerland (1904).

Four examples of the dragon-fly, *Sympycna fusca*, captured at Hyeres (March 20–April 17, 1904) by Dr. T. A. Chapman, were presented by W. J. Lucas, Esq., B.A., together with another species of the same group, *Oxygastra curtisii*, also from France.

Eleven hundred and thirty-four specimens from Algeria, including a few Arachnida, Myriopoda, and Crustacea, were presented by the captor, Dr. G. B. Longstaff, D.M., New College. Of this valuable and most welcome collection no less than 802 specimens have been catalogued for permanent incorporation. The species belong for the most part to the Lepidoptera, Hymenoptera, and Coleoptera. The insects were taken between Feb. 6 and April 3, 1905, at and in the neighbourhood of the following localities:—Algiers, Biskra, Hammam Meskoutine, Gorge de Chabet, Cape Okas, Bougie, Blida, and Hamman Righa.

Among the most valuable points of this collection are the

early spring butterflies, particularly the fine series of Pierine species, of which 97 have been catalogued; and the 289 catalogued Hymenoptera Aculeata, all named by Mr. Edward Saunders, F.R.S. The collection is not only of special value from the excellence and fullness of the data, and the interest of the locality, which has hitherto been barely represented in the Department, but also because the species have been very largely determined and bear their names in the Algerian notebook and on special labels affixed to the specimens. In the very considerable work of identification the Department is indebted to the generous donor, and those naturalists who have assisted him:—Mr. Edward Saunders, F.R.S., Mr. C. O. Waterhouse, Sir George Hampson, Mr. C. J. Gahan, Mr. G. J. Arrow, Col. J. W. Yerbury, Mr. E. E. Austen, and Mr. W. F. Kirby.

ADDITIONS TO THE BRITISH COLLECTIONS IN 1905.

The following valuable additions to the Collections of British Insects are owing to the kindness of Col. J. W. Yerbury:—

A hundred and sixteen Coleoptera from the neighbourhood of Barmouth (1902), 37 from Porthcawl, S. Wales (1902), and 10 from Torcross, S. Devon (1903).

Forty-eight flies belonging to the *Phycodromidae*, *Sciomyzidae*, and *Borboridae*, captured under sea-weed, Dec. 25, 1904, at Fowey, Cornwall. All the species have been named by Col. Yerbury and J. E. Collin, Esq., F.E.S.

Col. Yerbury also presented 5 Coleoptera and 1 Hemipteron from Darenth Wood, Kent (May 7, 1905); 12 Coleoptera and 2 Hemiptera from Brockenhurst, New Forest (April 6–27, 1905); 46 Rhynchota (chiefly Hemiptera), of which 19 have been catalogued, from Porthcawl, S. Wales (May 13–July 1, 1903).

Eleven Coleoptera (7 catalogued), captured by Lieut. J. J. Jacobs, R.E., at Sheerness (May 5–12, 1905), were presented by Commander J. J. Walker, Hon. M.A. The specimens include a fine series of *Helops coerulea*.

Four specimens of the Tineid moth, *Coleophora laricella*, bred in the Department, May 28, 1904, from larch gathered at Bradfield, were presented by Miss Steevens.

Five butterflies showing injuries to the wings, probably in part at least caused by the attacks of enemies, were presented by the captor, A. J. Chitty, Esq., M.A., Balliol College. The specimens were taken in the Faversham district of Kent, Sept. 12, 1905.

Four Tachinid flies bred in the spring of 1905 from a larva of *Saturnia carpini* ("The Emperor Moth"), found on Chobham Common, Surrey, in the Autumn, 1904, were presented by Miss C. B. Sanders, of Lady Margaret Hall.

Ninety-two insects of various Orders out of a somewhat larger collection from the neighbourhood of Mortehoe, N. Devon, were presented by Dr. G. B. Longstaff, D.M., New College. The great majority of the insects were taken in May, 1905, the captors being Dr. Longstaff, J. Young, Esq., and A. L. Onslow, Esq. The collection includes a fine series of the local "Greasy Fritillary" (*Melitaea aurinia*).

A valuable contribution to the collection of British Lepidoptera is contained in the specimens presented by Mr. J. Collins of the Hope Department. These are chiefly from the northern districts so imperfectly represented in the University Collection—from Warrington and the neighbouring Risley Moss, Rixton Moss, and Walton, and from Delamere Forest, Cheshire. The captures, made in the years 1899, 1903, and 1904, include 2 specimens of the "Marsh Ringlet" butterfly, *Coenonympha davus*, var. *rothliebii*, and the following moths—7 *Hydraecia petasitis*, 7 *Apamea unanimis*, 9 *Mixodia schultziana*, 13 *Retinia buoliana*, 2 *Amphisa gerningana*, 2 *Crambus margaritellus*, 2 *Crambus warringtonellus*. In addition to these, several insects from the Oxford district (1905) are mentioned below. The insects presented by Mr. Collins include altogether 67 specimens, of which 48 have been catalogued.

Thirty-one insects, of which 28 have been catalogued, were presented by the captor, Mr. A. H. Hamm, of the Hope

Department. They include 8 specimens of the interesting "Pigmy Footman" moth (*Lithosia pygmaeola*), from its only British locality, Deal (Aug., 1905), 6 of the local "dragon-fly," *Lestes sponsa*, from Deal (Aug., 1905), and an example of the dark-winged Tenthredinid, *Arge coerulescens*, and a dark-winged mimicking fly, *Sciara thomae*, taken on the same group of flower-heads, at Lyndhurst, Aug. 13, 1903. Several insects from the Oxford district, also included in this donation, are mentioned below.

Fifty-two insects from a great variety of localities were presented by W. J. Lucas, Esq., B.A. They include many Odonata ("dragon-flies") for the University Collection so kindly named and arranged by Mr. Lucas. The other orders represented in this welcome donation are the Hymenoptera, Diptera, Hemiptera and Orthoptera.

The remaining British specimens were captured in the Oxford district in 1905:—

A fine set of 6 *Hoporina croceago*, bred from a female moth captured at sallow in Bagley Wood, Oxford (April 3), were presented by J. S. Carter, Esq., M.A., of Radley College.

A specimen of *Vanessa urticae* ("Small Tortoise-shell butterfly"), hybernating in the Radcliffe Library (captured March 20), was presented by Dr. W. H. Jackson, D.Sc., M.A., Keble College.

A specimen of the Noctuid moth, *Euplexia lucipara*, captured in the house, Oxford (June 29), was presented by Mr. Alfred Robinson.

A large Lycosid spider, found alive (April 7) in Circus Yard, Church St., St. Ebbe's, Oxford, was presented by Mr. C. Ellis. The Arachnid, which was kept alive in the Department for many months, had probably been introduced into the country accidentally, in bananas or other vegetable imports.

The mimetic "wasp beetle," *Clytus arietis*, from a garden in the Leckford Road (May 15), was presented by W. Myres, Esq.

The "tiger moth" (*Arctia caja*), from the Southmoor Road (July 12), was presented by Mr. C. R. Browning.

The "Death's Head moth" (*Acherontia atropos*), found in a garden in Plantation Road (June 10), was presented by Mr. F. Bradfield.

A Staphylinid beetle, *Homalota vicina* (Nov. 27), and 6 winged specimens of the interesting ant *Lasius umbratus* (Sept. 31), found in the University Museum, a bred specimen of the "Lime Hawk-moth" (*Smerinthus tiliae*), and the moth *Aventula flexula*, found in Wykeham House (July 20), were presented by the Professor.

Twelve specimens of an interesting Hemipteron (8 catalogued) captured in the garden of the North Lodge, The Parks (July 13), were presented by Mr. H. Mount.

The following specimens from the neighbourhood of Oxford were presented by Commander J. J. Walker, Hon. M.A.:—

Two examples of *Hystricopsÿlla talpae*, the largest known flea, from a mouse's nest on Boar's Hill (April 22); 8 insects from Bagley Wood, Wytham Park, and Yarnton, including, from the latter locality (Jan. 12), 4 specimens of the rare Staphylinid beetle, *Lathrobium filiforme*, new to the Oxford district.

Fourteen insects from various localities were presented by Mr. W. Holland, of the Hope Department. They include an example of "the Comma butterfly" (*Grapta C.-album*), taken in Wychwood Forest, near Charlbury, on June 26, when many other specimens were seen. This record is of much interest to local naturalists, as the species has not been seen in this part of the Oxford district for many years. Another interesting specimen is a variety of the Geometrid moth, *Amphasis betularia*, somewhat transitional towards the well-known black variety, *doubledayaria*.

Among the series of British specimens presented by Mr. A. H. Hamm and Mr. J. Collins are several from the Oxford district. A specimen of the "Chalk-Hill Blue" (*Lycaena corydon*), captured, Aug. 8, at the Quarry near the Old Windmill on the Shotover Road, and a specimen of the "Satin moth" (*Liparis salicis*), seen to be seized and rejected, after tasting, by a sparrow, Southfield Road (July 9), are of

special interest in Mr. Hamm's donation from this neighbourhood; while *Crepidodera nitidula*, a beetle new to the Oxford district, from Bagley Wood, June 10, is of special interest among the local specimens presented by Mr. Collins.

A few specimens from S. Hincksey are included in the series of British insects presented by W. J. Lucas, Esq., B.A. (see above).

Among the additions to the bionomic series of predaceous insects and their victims (see p. 605) are many from the Oxford district; but it was thought better to keep the whole set together.

The Hope Library.

A cabinet has been purchased to accommodate the parts of the card catalogue which Miss Bellamy has completed. These are arranged and in constant use. In the early part of 1905 the direction of the work was in the hands of Dr. F. A. Dixey; later on Mr. W. Holland gave much time to the work, while towards the end of the year Mr. R. Shelford undertook the control of the Library, and has devoted much attention to the arrangement and the card catalogue.

A considerable amount of binding has been done, but not enough to make much impression upon the stupendous accumulation of arrears.

The following works were presented in 1905:—

Ottawa Experimental Farms: 5 memoirs, presented by Dr. W. Saunders, by the following authors:—C. E. Saunders, Esq. (1 memoir); Dr. J. H. Griedale, F. T. Shutt, Esq., and J. Fletcher, Esq. (1 memoir); Dr. W. Saunders (2); and Dr. W. Saunders and C. E. Saunders, Esq. (1).

Experimental Station of the Hawaiian Sugar Planters Association: 6 monographs by Dr. R. C. L. Perkins, D.Sc., M.A., Jesus College.

Sarawak Museum: Report for 1904.

University of Liverpool, Department of Zoology: Report.

New York State Museum: Report 561–4, 1904.

Smithsonian Institution: Report for 1903.

Manchester Museum, Owens College: Report for 1904–5, also a paper by the late Right Hon. T. H. Huxley.

Michigan Academy of Science: Fifth Annual Report (1904).

Cambridge University: Thirty-ninth Annual Report of the Museum and Lecture Room Syndicate (1904).

Radcliffe Library: Catalogue of Books for 1904.

The Boston Society of Natural History and the Bombay Natural History Society presented their publications for the year 1905.

The volumes of the "Novitates Zoologicae" of the Tring Zoological Museum, published in the year 1905, were presented by the Hon. Walter Rothschild.

Smithsonian Institution (United States National Museum, Washington) presented valuable memoirs by the following writers:—W. D. Kearfott, Esq.; W. H. Ashmead, Esq. (4 memoirs); Dr. Harrison G. Dyar (4 memoirs); Miss H. Richardson (3 memoirs); Carl F. Baker, Esq.; W. Schaus, Esq. (3 memoirs); W. Warren, Esq.; E. B. Williamson, Esq.; C. B. Wilson, Esq.

Carnegie Institution, Washington, presented memoirs by W. E. Castle, Esq.; G. H. Shull, Esq.; D. MacDougal, Esq.

Brooklyn Institution of Arts and Science: Memoirs by Miss E. M. Briggs; A. C. Dimon, Esq.; Miss M. E. Smallwood; C. Schaeffer, Esq.

The publications of the Linnean Society for the year 1905 and the Transactions of the Entomological Society of London for 1905 were presented by the Professor.

The following Authors also presented original papers: C. J. With, Esq.; Professor T. Hudson Beare (2 memoirs); Walter B. Collinge, Esq.; Señor Don Ignacio Bolivar (4 memoirs); Rev. T. R. R. Stebbing, M.A., F.R.S., Worcester College; Guy A. K. Marshall, Esq.; H. G. Kerville, Esq.; R. Shelford, Esq., M.A. (2 memoirs); Dr. William E. Hoyle, D.Sc., M.A., Christ Church; E. E. Austin, Esq. (2 memoirs); M. Burr, Esq.; C. O. Waterhouse, Esq.; Herbert Druce, Esq., F.L.S., F.Z.S.; Hamilton H. Druce, Esq., F.L.S.; N. Annandale, Esq., B.A., Balliol College (2

memoirs); W. F. Kirby, Esq., F.L.S. (5 memoirs); M. L. Bordas, Esq. (5 memoirs); Professor C. Aurivillius (3 memoirs); Dr. Karl Jordan (2 memoirs); F. W. Terry, Esq.; P. B. Hadley, Esq.; Professor Y. Nusima.

Lieut.-Colonel C. T. Bingham: Fauna of British India including Ceylon and Burma, Hymenoptera, Vol. I, presented by the Author.

Lieut.-Colonel C. T. Bingham: Fauna of British India including Ceylon and Burma, Butterflies, Vol. I, presented by the Secretary of State for India in Council.

Dr. W. J. Holland: "The Moth Book, a guide to the knowledge of Moths of America," presented by the Author.

The following valuable works were presented by the Trustees of the British Museum:—

Catalogue of the Noctuidae, Vol. V, by Sir G. F. Hampson.

A Synonymic Catalogue of Orthoptera, Vol. I, by W. F. Kirby.

M. Burr, Esq., F.E.S., presented papers by Rdo. P. Longinos Navás, H. N. Humphreys, Esq., and Dr. R. Gestro.

R. Shelford, Esq., M.A., F.L.S., presented papers by Dr. G. Nobili, G. D. Haviland, Esq., Martin Jacoby, Esq., F.E.S., and H. C. Robinson, Esq.

The Transactions of the Entomological Society of London for 1904, bound in 2 vols, presented by G. A. Rothney, Esq., F.E.S., in continuation of the generous gift acknowledged in the last Report. The same donor also presented a monograph by P. Cameron, "Description of new species of *Sphegidae* and *Ceropalidae*," 3 parts.

Dr. G. B. Longstaff, D.M., New College, presented: H. Stichel and H. Riffarth—"*Heliconiidae*," from Das Tierreich, 22 Lieferung, 1905.

"Among the Butterflies and Flowers of Majorca," from *Nature Notes*, was presented by A. H. Jones, Esq., F.E.S.

"Fasciculi Malayenses," App. Vol. II, Feb., 1905, presented by M. Jacoby, Esq., F.E.S., together with fasciculi 32 and 33 of his important monograph on the Coleoptera Phytophaga in "Genera Insectorum."

PURCHASES.

The following publications of the year 1905 were purchased for the Department:—The parts of Barrett's "British Lepidoptera," the Ray Society volume, the volume of the Zoological Record, the numbers of the "Entomologist's Monthly Magazine," the "Entomologist," and the "Entomologist's Record."

In addition to the above—the normal expenditure for many years—there were purchased:—G. R. Waterhouse, "Catalogue of British Coleoptera," 1861; Dr. C. Brunner v. Wattenwyl, "Monographie der Proscopiden"; J. Redtenbacher, "Monographische Uebersicht der Mecopodiden."

E. B. POULTON.

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